INSTRUCTION MANUAL

MODULAR MICROWAVE SIGNAL GENERATORS MODELS 1607E AND 1608E

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Polarad Electronics, Inc. 5 Delaware Dr. Lake Success N.Y. 11042 Tel: 516-328-1100 TWX: 510-223-0414

OCTOBER 1980

Instrumentation

Warranty

polarad electronics, inc.

We warrant each new instrument to be free of defects in materials and workmanship.

We will service, repair and adjust as required any instrument which proves defective within one year after date of delivery and which is returned to our factory (or other authorized depot) for that purpose.

For warranty information or other assistance, please contact Polarad Customer Service Department in Lake Success, New York, or an authorized regional service depot.

No other warranty is expressed or implied. No liability is assumed for consequential damages.

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INSTRUCTION MANUAL CHANGE BULLETIN

THIS BULLETIN APPLIES TO:

MODEL(S): 1607E
SERIAL NO.:
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Page 1-3, Table 1-2: Change as follows:

Characteristic	Specification
Uncalibrated Power Output	1607E: ≥10 mw from 3.7 to 7.6 GHz ≥ 5 mw from 7.6 to 8.4 GHz

This bulletin should be carefully examined since it contains information vital for updating this manual and for incorporating changes made after publication date. Bulletins are issued to insure that the manual contains current information and reflects the characteristics of the instrument for which it is intended.

For additional information, please contact Polarad's instrument application specialists for maintenance assistance, or our Customer Service Department.

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Figure 1-1. Model 1608E Modular Microwave Signal Generator

SECTION I

INTRODUCTION

1-1. SCOPE OF MANUAL

1-2. This manual contains instructions for the use and maintenance of the Modular Microwave Signal Generators, Models 1607E and 1608E (figure 1-1), manufactured by Polarad Electronics Inc., Lake Success, New York. The manual includes a general description of the instruments, installation procedure, theory of operation, operating instructions and maintenance.

1-3. Models 1607E and 1608E each consists of modulators and a modular signal generator. Model 1607E consists of Models 1020A and 1107E; Model 1608E consists of Models 1020A and 1108E. They can either be placed on a test bench, or they can be mounted in a standard 19" rack by simply reversing the handles at either end of the instruments.

1-4. The theory of operation, maintenance data, and parts list for the individual instruments comprising Models 1607E and 1608E, as well as individual general descriptions of the component instruments, are contained in the following Polarad instruction manuals which are part of the Model 1607E and 1608E manual.

1. Modular Microwave Modulator Model 1020A

2. Modular Microwave Signal Generators
   Models 1107E and 1108E

1-5. The manuals for the individual instruments are either supplied separately or bound into this manual depending on the ordering instructions received.

1-6. PURPOSE AND USE OF THE INSTRUMENTS.

1-7. Models 1607E and 1608E are general purpose broad band signal generators. The frequency ranges of the instruments are:

Model 1607E . . . . . 3.7 to 8.4 GHz
Model 1608E . . . . . 6.95 to 11.00 GHz

They provide spectrally pure CW signals and include modulation facilities for FM, square wave and widely adjustable pulsed outputs. The CW output signals of Models 1607E and 1608E are directly calibrated from −127 dBm up to +3 dBm. Greater output signal levels are provided by use of the uncalibrated segments of the attenuator scales. The available uncalibrated output levels are adjustable to the following levels:

Model 1607E: $\geqslant$ 10 mw from 3.7 to 7.6 GHz
$\geqslant$ 5 mw from 7.6 to 8.4 GHz

Model 1608E: $\geqslant$ 10 mw from 6.95 to 11.0 GHz

1-8. Typical uses of Models 1607E and 1608E are as reference signal generators to test broad- and/or narrow-band microwave systems and components such as antennas, attenuators, beacons, crystal mounts, hybrid structures, preselectors, radars, receivers and amplifiers. They can be used to make specific measurements such as bandwidth, insertion loss, frequency calibration, image rejection ratio, sensitivity, signal to noise ratio, VSWR, FM, square wave, and pulsed modulation tests, etc.

1-9. The signal generators of Models 1607E and 1608E incorporate phase lock provisions to increase frequency stability when the instruments are used with an external frequency stabilizer. The signal generators also incorporate provisions for external motor drive for tuning. An extension of the tuning shaft protrudes through the rear panel of the signal generators for this purpose.

1-10. The modulator outputs of Models 1607E and 1608E can be used to modulate other instruments simultaneously with their use in Models 1607E and 1608E. The modulator provides amplitude and frequency modulation for signal generators, signal sources, and oscillators. It provides pulse, square wave, and sawtooth outputs, and delayed or undelayed sync pulses for synchronization.

1-11. GENERAL DESCRIPTION.

1-12. The compact modular Microwave Signal Generators, Models 1607E and 1608E, are identically-sized. They are suitable for bench or rack use. The modulator and signal generator instruments used in Models 1607E and 1608E are AC line-powered. The instruments that comprise Models 1607E and 1608E consist of front and rear panels, a chassis or frame, and dust covers. The panels serve as a mounting for the operating controls and input/output connectors. The handles at either end of the signal generator front panels are reversible for bench or rack use. The dust covers, which are side, top, and bottom panels, enclose and protect the internal components of the instruments.

1-13. EQUIPMENT SUPPLIED.

1-14. Table 1-1 lists the equipment supplied for the Models 1607E and 1608E instruments.

1-15. EQUIPMENT SPECIFICATIONS.

1-16. Table 1-2 lists the equipment specifications for the Models 1607E and 1608E instruments.

1-17. OPERATION, THEORY OF OPERATION, MAINTENANCE, AND PARTS LIST.

1-18. For operation, theory of operation, maintenance, and parts list of the individual modules comprising Models 1607E and 1608E, refer to the handbooks listed in paragraph 1-4.

TABLE 1-1. EQUIPMENT SUPPLIED

Qty	Item	Polarad Model or Part Number	
1	Modular Microwave Signal Generator, consisting of:	1607E	1608E
(1)	Modular Microwave Modulator	1020A	1020A
(1)	Modular Microwave Signal Generator	1107E	1108E
1	Power Cable	B160833	
1	Power Jumper Cord	B160826	
1	RF Cable Assembly	B12551	
1	Test Connector	A713772	
1	Spanner Wrench	AP15550	
2	Video Cable Assembly	C147363	
1	Operating and Maintenance Instructions		
1	1/8 Amp Fuse (230 VAC)		
1	1/4 Amp Fuse (115 VAC)		

TABLE 1-2. EQUIPMENT SPECIFICATIONS

Characteristic	Specification
Frequency Range	
Model 1607E	3.7 to 8.4 GHz
Model 1608E	6.95 to 11.0 GHz
ΔF Control Range	1.5 MHz, minimum
Frequency Accuracy	±0.5% (Digital readout)
Frequency Stability	0.0008% per volt change in line voltage, 0.005% per degree C ambient
Calibrated Power Output	+6 dBm to −130 dBm
Power Monitor Range	−3 dBm to +3 dBm
Attenuator Dial Range	+3 dBm (0.310 volts) to −127 dBm (0.1 microvolts)
Output Power Absolute Accuracy	1607E: ±2 db (+3 dBm to −127 dBm) 3.7 to 8.2 GHz* 1608E: ±2 db (+3 dBm to −127 dBm) 6.95 to 11.0 GHz*
Uncalibrated Power Output "P" Option includes an auxiliary panel mounted power meter with calibration from +5 to +13dBm, accuracy ±1 dB typical, used for measurement of signal generator power at the end of the RF cable and external signals.	1607E: ⩾10mw from 3.7 to 8.0 GHz ⩾ 5mw from 8.0 to 8.4 GHz 1608E: ⩾ 10 mw from 6.95 to 11.0 GHz
Output	
Impedance	50 ohms nominal
VSWR	2:1 maximum
Connector	Type N
RF Monitor Output	−10 dBm minimum
Types of Output Available	CW, square wave, pulse and FM
Modulation — Generated with Model 1020A Internal Modulation, Internally or Externally Synchronized	
Square Wave Frequency	10 Hz-10 KHz continuously adjustable
Pulse Repetition Rate	10 Hz-10 KHz continuously adjustable
Width	0.2 to 2000 μsec continuously adjustable

*When power monitor meter is set to CAL

TABLE 1-2. EQUIPMENT SPECIFICATIONS (Continued)

Characteristics	Specifications
Rise and Decay Times	1607E: ≤0.15 μsec 1608E: ≤0.1 μsec
FM	
Type	Sawtooth
Frequency	10Hz — 10 kHz continuously adjustable
Sweep Width (Deviation X2)	Continuously adjustable, 0 to 7.5 MHz, typical (See other FM functions for sweeps adjustable to 10 MHz)
External Pulse Modulation (EXT INPUT of 1020A)	
Repetition Rate	Single pulse to 100 KHz rate
Pulse Width	0.5 to 2500 μsec
Polarity	Positive or negative
Input Amplitude	5 to 70 volts peak
Synchronization	
Sync Outputs, Delayed and Undelayed (Separate Outputs)	
Repetition Rate	10 to 10,000 pps
Amplitude	≥+25V peak into 1K ohms load.
Delay	0.3 to 2,000 μsec, continuously adjustable
External Sinewave Input Sync	
Frequency	10 Hz - 10 kHz
Amplitude	5 to 50 vrms
External Pulse Sync Input	
Repetition Rate	Single pulse to 10,000 pps
Amplitude	5 to 50V peak
Polarity	Positive or negative
Pulse Width	0.5 to 5 μsec
Rise Time	0.1 to 1 μsec
Modulation — Generated with Models 1107E and 1108E (Model 1020A is not used)	
Internal Square Wave	
Rate	950 to 1050 Hz (minimum)
On-Off Ratio	Infinite
Synchronization	Internal
Internal FM	
Rate	Power line frequency
Sweep Width	Continuously adjustable to 10 MHz
Horizontal Sweep Output	2 volts p-p, minimum, line power frequency
Horizontal Sweep Phase	Adjustable to 90°, minimum

TABLE 1-2. EQUIPMENT SPECIFICATIONS (Continued)

Characteristic	Specification
External Pulse Modulation (EXT INPUT of Models 1107E or 1108E)	
Input Modulating Pulse	
Amplitude	15 to 50 volts peak, positive
Width	Width set to obtain desired output pulse width
Output Modulated Pulse	
Width	0.2 to 2500 μsec
Rise and Delay Time (when input pulses have significantly faster rise times)	Model 1607E: ⩽0.15 μsec Model 1608E: ⩽0.10 μsec
Rate	Single pulse to 100 KHz
External FM Modulation	
Type and Rate	Any waveshape having frequency components between 10 Hz and 0.5 MHz
Sweep Width	Adjustable to 10 MHz, typical
EXT FM Input Coupling	Capacitive coupled to klystron repeller
Power Requirements	115 or 230 volts ±10%, 50-60 Hz, 150 watts (50-400 Hz optional, add suffix "F" to model number)
Dimensions	7"(17.8 cm) H x 16¾"(42.5 cm) W x 16¼"(42 cm) D
Weight	51 pounds (23 kg)
Accessories Supplied	RF Cable Assembly, Spanner Wrench, Video Cables

SECTION II

OPERATION

2-1. GENERAL.

2-2. Models 1607E and 1608E are shipped complete and ready to operate; no special or permanent installation procedures are required. The instrument shall be unpacked upon receipt, observing the usual precautions customary when unpacking an electronic instrument.

2-3. INSTALLATION.

2-4. After unpacking the instrument, plan its installation. If the unit will be used on a bench or cart, the required dimensions are shown in figure 2-1. If the unit is to be used in a rack, the handles at either end of the front panel should be reversed for rack mounting as shown in figure 2-1. The instrument requires 115/230 volts, single phase, 50/60 Hz ac power.

Note

Models 1607E and 1608E are shipped ready for 115 vac operation. If the instrument is to be operated from a 230-volt source, set the 115/230 volt switch,located on the rear panels of the Models 1107E/1108E and 1020A to the 230 volt position. Replace the fuse in the Model 1107E/1108E with the 0.75 amp fuse and the fuse in Model 1020A with the 1/8 amp fuse, both of which are supplied in the accessory kit.

2-5. OPERATING CONTROLS, INDICATORS, AND CONNECTORS.

2-6. The operating controls, indicators, and connectors of the Model 1607E/1608E are listed in Table 2-1 and shown in Figure 2-2.

2-7. MODEL 1607E/1608E OPERATION

2-8. To operate Model 1607E/1608E, proceed as follows:

a. Connect power jumper cable B160826 between the AC OUTPUT connector of Model 1020A Modulator and the AC INPUT connector of the Signal Generator.

b. Set the POWER switches of the Modulator and the Signal Generator to their OFF positions.

c. Connect video cable C147363 between the ⎍⊓ OUT connector on the Modulator and the EXT MOD connector on the Signal Generator.

d. Connect the other video cable C147363 between the FM OUT connector on the Modulator and the EXT FM connector on the Signal Generator.

e. Connect power cable B160833 between the AC INPUT connector of the Modulator and the external ac power source.

f. Turn the POWER switches on the Modulator and the Signal Generator to ON and allow the instruments to warm up for 20 minutes. Power indicator lamp on the Signal Generator and the POWER ON indicator lamp on the Modulator should illuminate indicating power is being applied to the instruments.

2-9. CW OPERATION. For CW operation, proceed as follows:

a. Set the FREQUENCY GHz control of the Signal Generator to the desired frequency.

b. Set the FUNCTION switch of the Modulator to OFF.

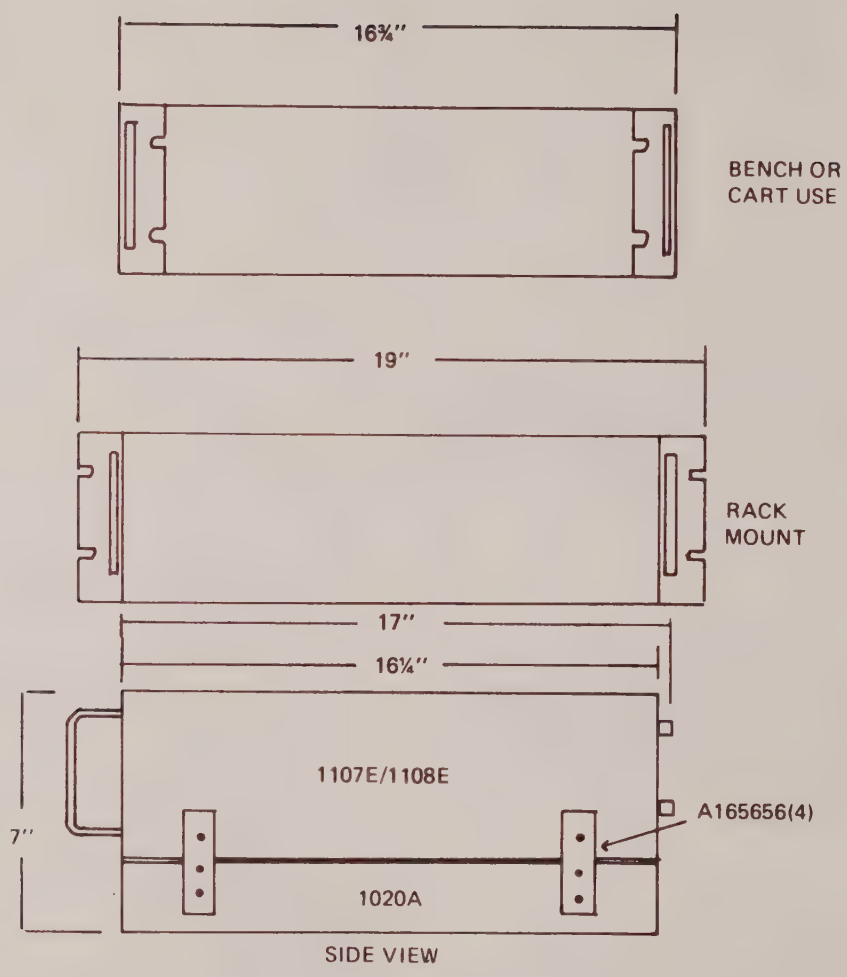

Figure 2-1. Outline Installation Drawing

c. Set the MODULATION SELECTOR switch of the Signal Generator to CW.

CAUTION

It is possible to make the Signal Generator inoperative by driving the attentuator probe too far into the oscillator cavity of the Signal Generator. If this occurs, back off the attenuator by turning the ATTENUATOR control counterclockwise and switch the MODULATION SELECTOR switch to RF OFF and then repeat the operating procedure.

d. Adjust the POWER SET control of the Signal Generator for a reading of CAL on the power monitor meter.

e. Adjust the ATTENUATOR control to read the desired output power level on the attenuator dial.

2-10. INTERNAL SQUARE WAVE MODULATION OPERATION. For internal square wave modulation operation, perform steps a through e of paragraph 2-9 and proceed as follows:

a. Set the FUNCTION switch of the Modulator to EXT ⎍ /INT ⎍.

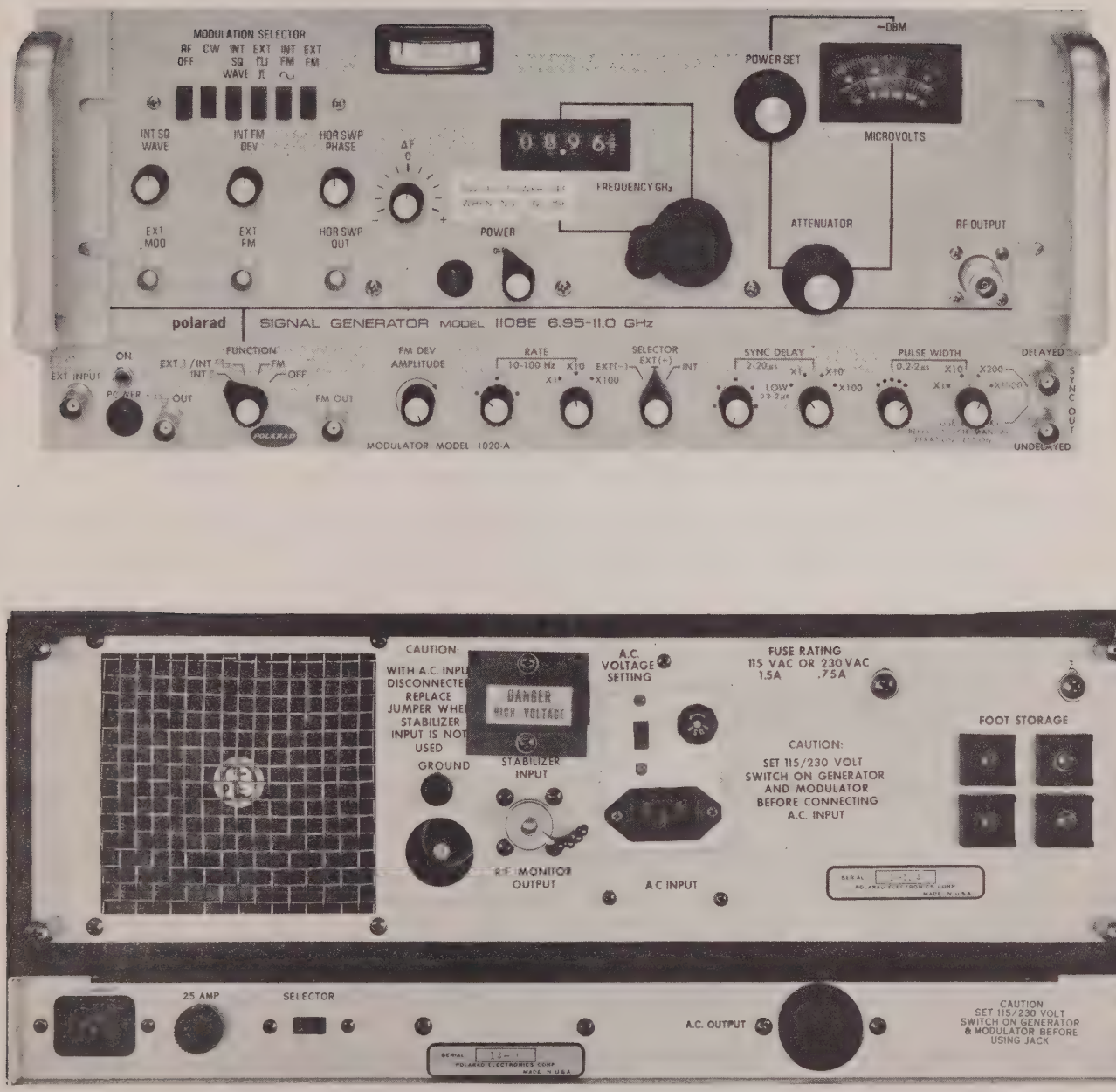

Figure 2-2. Operating Controls, Indicators and Connectors

TABLE 2-1. OPERATING INDICATORS, CONTROLS, AND CONNECTORS

Control, Indicator, or Connector	Function
MODEL 1107E/1108E	
POWER switch	Controls application of ac power
Power indicator lamp	Lights when ac power is applied to instrument
MODULATION SELECTOR switch	Selects type of modulation, as follows: RF OFF . . . . . .Disables rf output, standby position CW . . . . . No modulation present INT SQ WAVE . . . . Square wave modulation internal to Model 1107E/1108E EXT ⊓⊔⊓ . . . . . .Pulse modulation external to Model 1107E/1108E INT FM ~ . . . . . FM modulation internal to Model 1107E/1108E EXT FM . . . . . FM modulation external to Model 1107E/1108E
INT SQ WAVE control	Adjusts square wave frequency over the minimum range of 950 to 1050 Hz
INT FM DEV control	Adjusts amplitude of fm driving signal internal to Model 1107E/1108E
HOR SWP PHASE control	Controls phase of horizontal sweep signal to oscilloscope
EXT MOD connector	Accepts pulse or square wave modulation signal external to Model 1107E/1108E
EXT FM connector	Accepts fm signal external to the Model 1107E/1108E
HOR SWP OUT connector	Output for horizontal sweep signal to oscilloscope
FREQUENCY GHz dial	Displays digital frequency readout of instrument frequency
Frequency control	Adjusts instrument frequency
RF OUTPUT connector	RF output available for use
ATTENUATOR control	Adjusts output power level of instrument
RF MONITOR OUTPUT connector*	Used for automatic frequency stabilization
STABILIZER INPUT terminals*	Used for automatic frequency stablization or other auxiliary use.
FUSE*	Protects instrument from damage
ΔF Control	Fine frequency control. May be used to maximize system power output and control pulse jitter.
POWER SET control	Used to adjust oscillator power level for power monitor meter indication of CAL
Power monitor meter	Used to set power level of instrument for attenuator calibration
AC INPUT connector*	Power cord input
AC VOLTAGE SETTING switch*	Selected according to input power ac voltage level either 115 vac or 230 vac

*Located on rear panel.

TABLE 2-1. OPERATING INDICATORS, CONTROLS, AND CONNECTORS (Continued)

Control, Indicator, or Connector	Function
MODEL 1020A	
POWER switch	Controls application of ac power
ON indicator lamp	Lights when ac power is applied to instrument
EXT INPUT connector	Connects the Model 1020A to either externally synchronizing or externally pulse modulating signals
⎍ ⊓ OUT connector	Couples output pulse or output square wave to EXT MOD input jack on Model 1107E/1108E
FUNCTION switch	Selects internal pulse, internal square wave, internal FM, external pulse modulation, or no modulation
FM OUT connector	With FUNCTION switch in FM position, couples internally generated sawtooth waveform to EXT FM connector of Model 1107E/1108E
FM DEV AMPLITUDE control	When FUNCTION switch is in the FM position, adjusts the amplitude of the output sawtooth. (Adjusts deviation of rf outputs when MODULATION SELECTOR switch, on Model 1107E/1108E is set to EXT FM position)
RATE control and X1-X10-X100 multiplier switch	Adjusts pulse repetition rate from 10 to 10,000 Hz.
SELECTOR switch	Enables Modulating Output signals to be either internally or externally controlled. For external modulating signals, the controls are set as follows: a. Must be set to EXT(+) when a positive synchronizing pulse or a positive modulating pulse is externally applied. b. Must be set to EXT(−) when a negative synchronizing pulse or a negative modulating pulse is externally applied. c. May be set to EXT(+) or EXT(−) when a sine wave synchronizing signal is externally applied.
SYNC DELAY control and LOW-X1-X10-X100 multiplier switch	Adjusts delay between both rf output pulse and delayed sync output pulse from 0.3 to 2000 microseconds.
PULSE WIDTH control and X1-X10-X200-X1000 switch	Adjusts width of rf output pulse from 0.2 to 2000 μsec. X1 0.2 to 2 μsec X10 2.0 to 20 μsec X200 40 to 400 μsec X1000 200 to 2000 μsec Pulse width range overlap on the X10 and X200 multiplier position provides pulse width from 20 μsec to 40 μsec

TABLE 2-1. OPERATING INDICATORS, CONTROLS, AND CONNECTORS (Continued)

Control, Indicator, or Connector	Function
MODEL 1020A	
DELAYED SYNC OUT connector	Provides positive video trigger pulse in time coincidence with leading edge of rf output pulse.
UNDELAYED SYNC OUT	Provides positive video trigger pulse which leads both rf output pulse and delayed sync output pulse in time.
115/230 SELECTOR switch*	Selected according to input power ac voltage level
AC INPUT connector*	Connection for ac power cable
AC OUTPUT connector*	Connection for ac power cable between Model 1107E/1108E and Model 1020A

*Located on rear panel.

b. Set the SELECTOR switch of the Modulator to INT.

c. Set the MODULATION SELECTOR switch of the Signal Generator to EXT ⊓⊔ ⊓.

d. Adjust the RATE control of the Modulator for the desired rate.

2-11. INTERNAL PULSE MODULATION OPERATION. For internal pulse modulation operation, perform steps a through e of paragraph 2-9 and proceed as follows:

a. Set the FUNCTION switch of the Modulator to INT ⊓ .

b. Set the SELECTOR switch of the Modulator to INT.

c. Set the MODULATION SELECTOR switch of the Signal Generator to EXT ⊓⊔ ⊓.

d. Adjust the RATE and PULSE WIDTH controls of the Modulator for the desired pulse rate and width.

2-12. EXTERNAL PULSE MODULATION OPERATION. For external pulse modulation operation, perform steps a through e of paragraph 2-9 and proceed as follows:

a. Set the FUNCTION switch of the Modulator to EXT ⊓ /INT⊓.

b. Select the SELECTOR switch of the Modulator to EXT(+) or EXT (–) as determined by the externally applied pulse.

c. Set the MODULATION SELECTOR switch of the Signal Generator to EXT ⊓⊔ ⊓.

d. Connect the external modulating signal to the EXT INPUT connector of the Modulator.

Note

Undelayed or delayed sync out signals are available at the DELAYED SYNC OUT connector and/or the UNDELAYED SYNC OUT connector of the Modulator.

2-13. INTERNAL FM OPERATION (Internal to 1107E/1108/E). For internal fm operation (1107E/1108E) perform steps a through e of paragraph 2-9 and proceed as follows:

a. Set the MODULATION SELECTOR switch of the Signal Generator to INT FM~.

b. Adjust the INT FM DEV control to obtain the desired sweep width.

c. To observe the frequency response of a component or system under test proceed as follows:

(1). Feed the RF OUTPUT signal through a frequency meter to the item under test.

(2). Feed the detected output to the vertical input of an oscilloscope.

(3). The HOR SWP OUT is fed to the horizontal input of the oscilloscope.

(4). Set the oscilloscope vertical and horizontal gain for full scale deflection.

(5). Adjust the INT FM DEV control so that the FM deviation is sufficient to observe the frequency response.

(6). Adjust the HOR SWP PHASE control so that the forward and reverse sweeps are overlapped.

(7). Adjust the frequency meter to measure the frequency response by observing the frequency of the pip from the end of the reponse to the other.

2-14. INTERNAL FM OPERATION (1607E/1608E) (10 Hz to 10 KHz Sawtooth Rate). For internal FM operation perform steps a through e of paragraph 2-9 and proceed as follows:

a. Set the MODULATION SELECTOR switch of Signal Generator 1107E/1108E to EXT FM.

b. Set the FUNCTION switch to FM and the SELECTOR switch to INT on Modulator 1020A.

c. Adjust the RATE control and multiplier switch X1, X10, X100 on Modulator 1020A for the desired modulation rate.

d. Adjust the FM DEV AMPLITUDE control for the required deviation.

2-15. EXTERNAL FM OPERATION. To perform the external FM operation proceed as follows:

a. Connect an external modulating signal to the EXT FM connector.

b. Perform steps a through e of paragraph 2.9.

c. Set the MODULATION SELECTOR switch of the Signal Generator to EXT FM.

d. Set FUNCTION switch of the Modulator to OFF.

e. Set the external FM source to desired characteristics

2-16. EXTERNAL SYNCHRONIZATION. For external triggering of the internal pulse or external synchronization of the internal fm signal, proceed as follows:

a. Connect the external trigger or synchronizing to the EXT INPUT connector of the Modulator.

b. Set the SELECTOR switch of the Modulator to either EXT(+) for a positive input or EXT(—) for a negative input.

c. Set the FUNCTION switch to INT ⎍.

2-17. PACKAGING INSTRUCTIONS.

2-18. PACKAGING FOR SHORT TERM STORAGE. If the instrument is to be stored for a relatively short period, cover it with a suitable protective covering such as a sheet of plastic or paper. Put the accessories and instruction manual in an envelope or bag and fasten it to the instrument to prevent loss. Store the instrument in a clean and dry area where it will not be subjected to extreme temperatures. Save the packing material for future, safe shipping requirements.

2-19. PACKAGING FOR LONG TERM STORAGE OR SHIPMENT. If the instrument is to be stored for a long period of time or shipped, proceed as follows:

a. Save the original wrappings and carton and repackage the instrument in them. The original packing material properly cushions the instrument for shipment.

b. If the original packing has not been saved, call Polarad Electronics, Inc. for proper shipping instructions.

SECTION III

MAINTENANCE

3-1. GENERAL.

3-2. This section contains the minimum performance standards and troubleshooting procedures for the Model 1607E/1608E Signal Generator. For maintenance and alignment procedures for the individual components that comprise the Model 1607E/1608E, refer to the instruction manuals listed in paragraph 1-3.

3-3. TEST EQUIPMENT REQUIRED.

3-4. Table 3-1 lists the test equipment required for the maintenance of Model 1607E/1608E Signal Generator.

3-5. MINIMUM PERFORMANCE TESTS.

3-6. The minimum performance tests, detailed in paragraphs 3-7 through 3-20, will determine whether the instrument is operating within the specifications listed in table 1-2.

3-7. The Signal Generator is shipped, ready for operation, with the 115/230V switches of the Signal Generator and Modulator set for 115 vac. If the Signal Generator is to operate from a 230 volt ac supply, set the 115/230 volt switches of the Signal Generator and Modulator to 230V and insert the proper fuses. Connect power cable B160826 to the AC OUTPUT connector of the Modulator and the AC INPUT connector of the Signal Generator. Connect power cable B160833 to the AC INPUT connector of the Modulator and to the external power source. Set the POWER switches of the Modulator and Signal Generator to ON. Allow a 20-minute warm-up period before attempting any of the minimum performance tests. At the end of each test, disconnect the equipment.

3-8. FREQUENCY RANGE AND TUNING TEST. To perform the frequency range and tuning test, proceed as follows:

a. Set the FREQUENCY GHz control of the Signal Generator to 3.70 GHz (Model 1107E) or 6.95 GHz (Model 1108E).

b. Set the MODULATION SELECTOR switch of the Signal Generator to CW.

c. Adjust the ΔF control of the Signal Generator to the 0 position.

d. Adjust the POWER SET control of the Signal Generator for a reading of CAL on the power monitor meter.

e. Set the ATTENUATOR control of the Signal Generator for a reading of 0 dBm output on the attentuator dial.

f. Connect Systron Donner Model 6316 counter to the RF OUTPUT connector of the Signal Generator. The frequency reading within ±0.5% should be obtained.

g. Perform steps a through f at the following FREQUENCY GHz control settings:

1607E		1608E	
4.00	7.00	8.00	10.00
5.00	8.00	9.00	11.00
6.00	8.40		

3-9. OUTPUT POWER AND LEVEL ACCURACY TEST. To perform the output power and level accuracy test, proceed as follows.

a. Set the FREQUENCY GHz control of the Signal Generator to 3.7 GHz (Model 1607E) or 7.0 GHz (Model 1608E).

b. Set the MODULATION SELECTOR switch of the Signal Generator to CW.

c. Set the ΔF control of the Signal Generator to the 0 position.

TABLE 3-1. TEST EQUIPMENT REQUIRED

Item	Manufacturer and Model*	Use
Counter	Systron-Donner 6316	Frequency
Power Meter with Sensor	H-P 435A and H-P 8481A	RF Power Attenuation
Oscilloscope	Tektronix 541A	Modulation
Pre-Amplifier	Tektronix Type CA	Modulation
Pulse Generator	H-P 214A	Pulse/Sync
Pad	3 dB Applied Research HFA 50	Load
AC Power Source	Elgar 501A	EXT. FM
Detector	H-P 423B	Modulation Tests
Spectrum Analyzer	Polarad 640A	FM Deviation Spectral Purity

*NOTE: Equivalent equipment, produced by other manufacturers, may be substituted to obtain satisfactory performance.

d. Adjust the POWER SET control of the Signal Generator for a reading of CAL in the power monitor meter.

e. Set the ATTENUATOR control of the Signal Generator for a reading of 0 dBm output on the attenuator dial.

f. Set the MODULATION SELECTOR switch of the Signal Generator to RF OFF.

g. Connect H-P Power Meter H-P 435A to the RF OUTPUT connector of the Signal Generator and zero set on +5 dBm range.

h. Set the MODULATION SELECTOR switch of the Signal Generator to CW.

i. Power level should read 0 dBm ±2.0 dB adjusting the Power Meter range accordingly.

j. Repeat steps a through i at −10 dBm and −20 dBm.

k. Repeat steps a through i at 6.0 (9.0) and 8.4 (11.0) GHz.

Note

The attenuator is extremely accurate so that if the output accuracy at 0 dBm, −10 dBm, and −20 dBm are all within the specified limits, all other values below −20 dBm will be correct.

3-10. INTERNAL SQUARE WAVE MODULATION TEST. To perform the internal square wave modulation test, proceed as follows:

a. Connect the equipment as shown in figure 3-1.

b. Set FREQUENCY GHz of the Signal Generator to 3.70 GHz (Model 1607E) or 7.0 (Model 1608E).

c. Set the MODULATION SELECTOR switch of the Signal Generator to CW and the ΔF control to 0. Adjust the POWER SET control for an indication of CAL on the power monitor meter.

d. Adjust the ATTENUATOR control of the signal Generator for a reading of 0 dBm on the attenuator dial.

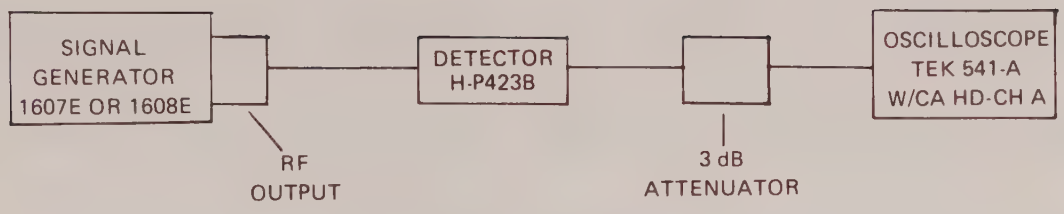

Figure 3-1. Modulation Characteristics Test Set-Up

e. Set the MODULATION SELECTOR switch of the Signal Generator to EXT ⎍ ⎍.

f. Set the Modulator controls as follows:

Control	Position
FUNCTION	EXT ⎍ /INT ⊓
RATE	X1
SELECTOR	INT
RATE Vernier	Fully clockwise

g. Set the oscilloscope for a square wave display.

h. Slowly rotate the RATE control vernier of the Modulator counterclockwise and observe the display on the oscilloscope. The square wave rate should decrease smoothly to a minimum of 10 KHz.

i. Set the RATE multiplier control to X100.

j. Slowly rotate the RATE control vernier of the Modulator clockwise. The display should increase smoothly beyond a rate of 10 KHz.

g. Repeat steps a through j at 6.0 (9.0) and 8.40 (11.0) GHz.

3-11. INTERNAL PULSE MODULATION TEST. To perform internal pulse modulation test, proceed as follows:

a. Connect equipment as shown in figure 3-1.

b. Perform steps b through e of paragraph 3-10.

c. Set FUNCTION switch of the Modulator to INT ⎍ and the SELECTOR switch to INT.

d. Set PULSE WIDTH vernier control of the Modulator fully counterclockwise and set the multiplier control to X1000.

e. Set RATE control of the Modulator fully clockwise and the RATE multiplier to X1.

f. Slowly rotate the PULSE WIDTH vernier control of the Modulator clockwise and observe that the pulse display on the oscilloscope increases in width smoothly until it goes to a maximum of 2000 microseconds.

g. Set PULSE WIDTH multiplier to X1 and RATE multiplier to X100.

h. Slowly rotate the PULSE WIDTH vernier control of the Modulator counterclockwise and observe that the pulse width on the oscilloscope decreases smoothly until it reaches a minimum of 0.2 microseconds.

i. Repeat steps a through h at 6.0 (9.0) GHz and 8.4 (11.0) GHz.

3-12. EXTERNAL PULSE MODULATION TEST. To perform the external pulse modulation test, proceed as follows:

a. Connect equipment as shown in figure 3-1.

b. Connect PULSE OUTPUT of Pulse Generator H-P 214A to the EXT INPUT connector of the Modulator using a BNC-T connector.

c. Connect the remaining terminal of the BNC-T connector to Channel B input of the Tektronix CA plug-in unit.

d. Trigger the oscilloscope externally from the TRIGGER OUTPUT connector of Pulse Generator H-P 214A.

e. Set the FREQUENCY GHz control of the Signal Generator to 6.0 (Model 1607E) or 9.0 GHz (Model 1608E).

f. Set the MODULATION SELECTOR switch of the Signal Generator to CW. Adjust the POWER SET control of the Signal Generator for an indication of CAL on the power monitor meter of the Signal Generator and ATTENUATOR control for 0 dB setting.

g. Set the MODULATION SELECTOR switch of the Signal Generator to EXT ⊓⊔ ⎍ .

h. Set the FUNCTION control of the Modulator to EXT ⎍/INT ⊓⊓ and the SELECTOR control to EXT(+) and set the PULSE OUTPUT and TRIGGER OUTPUT polarity of Pulse Generator H-P 214A to (+).

i. Set the oscilloscope for dual-trace display, observing input video and output detected pulse.

j. Set the PULSE WIDTH control of the Pulse Generator to 0.5 microseconds and the INT REP RATE control to 10 KHz.

k. Vary the AMPLITUDE control of the Pulse Generator from 15 to 70 volts peak and observe that the output detected pulse is steady.

l. Set the H-P Pulse Generator PULSE WIDTH to 2500 μsec and INT REP RATE control to minimum.

m. Observe the oscilloscope display for a steady output pulse as the Pulse Generator width is varied from 15 to 70 volts.

3-13. INTERNAL FM-DEVIATION TEST. To perform the internal FM-deviation test, proceed as follows:

a. Set the FREQUENCY GHz control of the Signal Generator to 3.70 GHz (Model 1607E) or 7.0 GHz (Model 1608E).

b. Set the MODULATION SELECTOR switch of the Signal Generator to CW. Adjust the POWER SET control of the Signal Generator for an indication of CAL on the power monitor meter and ATTENUATOR control for 0 dBm output.

c. Connect an RF coaxial cable between the RF OUTPUT connector of the Signal Generator and the RF INPUT connector of Polarad 640A Spectrum Analyzer.

d. Adjust the controls of the Spectrum Analyzer to display a 3.7 (7.0) GHz signal in the center of the screen.

e. Set the MODULATION SELECTOR switch of the Signal Generator to EXT FM.

f. Set the controls on the Modulator as follows:

Control	Setting
FUNCTION	FM
SELECTOR	INT
RATE	X100
RATE vernier	Approximate middle position

g. Rotate the FM DEV AMPLITUDE control of the Modulator until a maximum FM deviation is indicated on the Spectrum Analyzer.

h. Slowly rotate the RATE vernier control of the Modulator counterclockwise and observe that the FM deviation is still indicated on the Spectrum Analyzer.

i. Set the RATE control of the Modulator to X1 and set the RATE vernier control to its approximate middle position. Observe that the FM deviation is still indicated on the Spectrum Analyzer.

j. Repeat steps a through i at 6.0 (9.0) and 8.40 (11.0) GHz.

3-14. EXTERNAL FM-DEVIATION TEST. To perform the external FM deviation test, proceed as follows:

a. Set the FREQUENCY GHz control of the Signal Generator to 3.70 GHz (1607E) or 7.0 GHz (1608E).

b. Set the MODULATION SELECTOR switch of the Signal Generator to CW. Adjust the POWER SET control of the Signal Generator for an indication of CAL on the power monitor meter and ATTENUATOR control for 0 dBm output.

c. Connect an RF coaxial cable between the RF OUTPUT connector of the Signal Generator and the RF INPUT connector of Polarad 640A Spectrum Analyzer.

d. Adjust the controls of the Spectrum Analyzer to display a 3.70 (7.0) GHz signal in the center of the screen.

e. Connect a cable between the OUTPUT connector of Elgar Model 501A and the EXT FM connector of the Generator. Set the output level of the Model 501A to minimum.

f. Set the FREQUENCY control of Model 501A to 10 Hz.

g. Set the MODULATION SELECTOR switch of the Signal Generator to EXT FM.

h. Vary the AMPLITUDE control of Model 501A until an FM deviation of 5 MHz peak-to-peak is observed on the Spectrum Analyzer.

i. Change the FREQUENCY control of the Model 501A to 10,000 Hz and repeat step h.

j. Repeat steps a through i at 6.0 (9.0) GHz and 8.4 (11.0) GHz.

3-15. INTERNAL FM TEST. (Internal to Model 1107E/ 1108E). To perform the internal FM test proceed as follows:

a. Set the FREQUENCY GHz control of the Signal Generator to 3.70 GHz (Model 1607E) or 7.0 GHz (Model 1608E).

b. Set the MODULATION SELECTOR switch of the Signal Generator to CW. Adjust the POWER SET control of the Signal Generator for an indication of CAL on the power monitor meter and ATTENUATOR control for 0 dBm output.

c. Connect an RF coaxial cable between the RF OUTPUT connector of the Signal Generator and the RF INPUT connector of Polarad 640A Spectrum Analyzer.

d. Adjust the controls of the Spectrum Analyzer to display a 3.7 (7.0) GHz signal in the center of the screen.

e. Set the MODULATION SELECTOR switch to INT FM~.

f. Vary the INT FM DEV control until an FM deviation of 10 MHz peak-to-peak is observed on the Spectrum Analyzer.

g. Repeat steps a through f at 6.0 (9.0) GHz and 8.4 (11.0) GHz.

3-16. INTERNAL SYNCHRONIZATION DELAYED SYNC OUT TEST. To perform the internal synchronization delayed sync out test, proceed as follows:

a. Connect the equipment as shown in figure 3-1.

b. Set the FUNCTION switch on the Modulator to INT ⎍ and the SELECTOR switch to INT.

c. Connect the DELAYED SYNC OUT signal of the Modulator to the Vertical Input of the oscilloscope in parallel with a 1000 ohm resistor.

d. The level should be ⩾25 volts positive and the rise time should be ⩽1 microsecond simultaneously with the pulse.

3-17. DELAYED SYNC OUT TIMING TEST. To perform the delayed sync out timing test, proceed as follows:

a. Set up equipment as shown in figure 3-1.

b. Set the FREQUENCY GHz control of the Signal Generator to 3.70 GHz (1607E) or 7.0 GH z(1608E).

c. Set the MODULATION SELECTOR switch of the Signal Generator to CW. Adjust the POWER SET control of the Signal Generator for an indication of CAL on the power monitor meter.

d. Adjust the ATTENUATOR control for a reading of 0 dBm on the attenuator dial.

e. Set the controls on the Modulator as follows:

Control	Setting
FUNCTION	INT ⎍
RATE	X10
RATE vernier	Fully counterclockwise
SELECTOR	INT

Control	Setting
SYNC DELAY	X LOW
SYNC DELAY vernier	Fully counterclockwise
PULSE WIDTH	X1
PULSE WIDTH vernier	Fully clockwise

f. Connect the UNDELAYED SYNC OUT signal of the Modulator to the EXT TRIGGER INPUT of the oscilloscope.

g. Feed the DELAYED SYNC OUT signal of the Modulator to Channel B of the oscilloscope.

h. Connect the H-P 423B Detector output to Channel A of the oscilloscope.

i. Set the oscilloscope to the ALTERNATE mode and adjust the controls of the oscilloscope to obtain a stable display.

j. Observe a simultaneous start of the two pulses on the screen and that the delay is < 0.3 microseconds.

k. Set the SYNC DELAY control of the Modulator to X100 and rotate the SYNC DELAY control vernier clockwise until the delay is $\geqslant 2000$ microseconds.Note that the displayed pulses are delayed simultaneously.

3-18. EXTERNAL SYNCHRONIZATION SINE WAVE TEST. To perform the external synchronization sine wave test, proceed as follows:

a. Set up equipment as shown in figure 3-1.

b. Set the FREQUENCY GHz control of the Signal Generator to 3.7 GHz (1607E) or 7.0 GHz (1608E).

c. Set the MODULATION SELECTOR switch of the generator to CW. Adjust the POWER SET control of the generator for an indication of CAL on the power monitor meter and ATTENUATOR control for 0 dB output.

d. Set the Modulator controls as follows:

Control	Position
FUNCTION	INT ⎍
SELECTOR	EXT(+) or EXT(−)

e. Set the MODULATION SELECTOR control of the Signal Generator to EXT ⎍ ⎍.

f. Connect Elgar Model 501A output to the EXT INPUT connector of the Modulator.

g. Feed the Model 501A output signal simultaneously into Channel B and the RF detected pulse into Channel A of the oscilloscope and set the oscilloscope for a stable display.

h. Vary the Model 501A frequency at 5 volts rms between 10 and 10,000 Hz and check for a stable RF pulse.

i. Repeat step h at 50 volts rms.

3-19. EXTERNAL SYNCHRONIZATION PULSE TEST. To perform the external synchronization pulse test, proceed as follows:

a. Connect equipment as shown in figure 3-1.

b. Set the FREQUENCY GHz control of the Signal Generator to 3.7 GHz (1607E) or 7.0 GHz (1608E).

c. Set the MODULATION SELECTOR of the Signal Generator to CW. Adjust the POWER SET control of the Signal Generator for an indication of CAL on the power monitor meter and ATTENUATOR control on 0 dBm output.

d. Connect Pulse Generator H-P 214A to the EXT INPUT connector of the Modulator.

e. Set the Modulator controls as follows:

Control	Position
FUNCTION	INT ⎍
SELECTOR	EXT(+)

f. Set the MODULATION SELECTOR switch of the Signal Generator to EXT ⎍ ⎍.

g. Set the H-P 214 Pulse Generator for the following settings as measured on Channel B of the oscilloscope:

Pulse Repetition Rate	10,000 Hz
Pulse Width	0.5 microseconds
Amplitude	5V, positive

h. Set oscilloscope for ALTERNATE mode and adjust oscilloscope for stable display of the two pulses.

i. Reduce the pulse rate on the Pulse Generator from 10,000 Hz to minimum. Observe that, on Channel A of the oscilloscope, the output pulse is stable.

j. Set the amplitude of the Pulse Generator to 50 volts and repeat step i.

k. Set the pulse width of the Pulse Generator to 5 microseconds and repeat step i.

l. Set the amplitude of the Pulse Generator to 5 volts and repeat step i.

m. Repeat step i, except that the positive amplitude of the Pulse Generator is changed to the negative polarity and the SELECTOR switch on the Modulator is set to EXT(-).

3-20. TROUBLESHOOTING*

3-21. The troubleshooting procedure for Model 1607E/1608E is shown in Table 3-2. The procedure locates the fault to one of the components of the Signal Generator. For troubleshooting of the individual component, refer to the instruction manual for that component included in this manual.

WARNING

A REGULATED VOLTAGE OF -1750/-1850 VOLTS WILL BE ENCOUNTERED DURING THE TROUBLESHOOTING PROCEDURE. DO NOT CONNECT OR DISCONNECT TEST EQUIPMENT WHICH CONNECTS INTERNALLY WITH THE INSTRUMENT ENERGIZED.

*Polarad's Customer Service Department, Lake Success, New York and Polarad's service depots worldwide are always pleased to be of assistance.

Customer Service Department

Telephone: (516) 328-1100

TWX: (510) 223-0414

TABLE 3-2. TROUBLESHOOTING PROCEDURE FOR MODEL 1607E/1608E

Step	Purpose	Procedure	Normal Indication	Abnormal Indication Reference
1	Evaluate power operating conditions	Connect instrument under test to power source.	POWER indicator lights on Model 1107E/1108E and 1020A should illuminate	Check Models 1107E/1108E and 1020A.
2	Check power monitor meter function	Allow 20 minutes for the instrument to warm up. Set the MODULATOR SELECTOR switch, of Model 1107E/1108E, to CW. Adjust the POWER SET control, on Model 1107E/1108E for a reading of CAL on the power monitor meter.	Power monitor meter deflects to CAL	Check Model 1107E/1108E only
3	Check of internal FM operation	Set the instrument for a reading of CAL on the power monitor meter of Model 1107E/1108E. Connect an RF cable between the RF OUTPUT connector of Model 1107E/1108E and the RF INPUT connector of Polarad 640A Spectrum Analyzer. Center the signal in the CRT. Set MODULATION SELECTOR switch of Model 1107E/1108E to EXT FM. Set FUNCTION switch of Model 1020A to FM, SELECTOR switch to INT, Rate switch to X100, and the RATE vernier to its approximate middle position. Rotate the FM DEV AMPLITUDE control of Model 1020A.	FM deviation adjustable from 0 to maximum should be obtained.	Check Model 1107E/1108E and/or Model 1020A
4	Check of external FM operation.	Set the instrument for a reading of CAL on the power monitor meter of Model 1107E/1108E. Connect an RF cable between the RF OUTPUT connector of Model 1107E/1108E and the RF INPUT connector of Polarad 640A Spectrum Analyzer. Center the signal in the CRT. Connect a cable between the OUTPUT connector of Elgar Model 501A and the EXT FM connector of Model 1107E/1108E. Set the output level of Model 501A to minimum and set the FREQUENCY control to 10 Hz. Set the MODULATION SELECTOR switch of Model 1107E/1108E to EXT FM. Vary the AMPLITUDE control of Model 501A.	FM sweep width of 10 MHz,typical, should be obtained	Check Model 1107E/1108E only

TABLE 3-2. TROUBLESHOOTING PROCEDURE FOR MODEL 1607E/1608E (Continued)

Step	Purpose	Procedure	Normal Indication	Abnormal Indication Reference
5	Check internal pulse operation.	Connect equipment as shown in figure 3-1. Set the instrument for a reading of CAL on the power monitor meter of Model 1107E/1108E. Set the MODULATION SELECTOR switch of Model 1107E/1108E to EXT ⊓⊔ ⊓. Set the controls of Model 1020A as follows: FUNCTION switch to INT ⊓, SELECTOR switch to INT, PULSE WIDTH vernier control fully ccw and the multiplier control to X1000, RATE control fully clockwise and the RATE multiplier to X1. Slowly rotate the PULSE WIDTH vernier control clockwise.	Corresponding pulse characteristic of pulse, being supplied from Model 1020A should be obtained.	Check Model 1020A and/or Model 1107E/1108E.
6	Check external pulse operation.	Connect the instrument as shown in figure 3-1. Connect the PULSE OUTPUT of H-P 214A to the EXT INPUT connector of Model 1020A using a BNC-T connector. Connect the remaining terminal of the BNC-T connector to the Channel B input of the Tektronix CA plug-in unit. Trigger the oscilloscope externally from the TRIGGER OUTPUT connector of Pulse Generator H-P 214A. Set the instrument for a reading of CAL on the power monitor meter of Model 1107E/1108E and set the MODULATION SELECTOR switch to EXT ⊓⊔ ⊓. Set the FUNCTION control of Model 1020A to EXT⊓/INT ⊓⊓ and the SELECTOR control to EXT(+). Set the PULSE OUTPUT and TRIGGER OUTPUT polarity of Model H-P 214A to (+). Set the oscilloscope for a dual trace display and observe the input video and detected pulse. Set the PULSE WIDTH control of Model H-P 214A to 0.5 μsec and the INT REP RATE control to 10K. Vary the AMPLITUDE control of Model H-P 214A from 15 to 70 volts peak.	RF detected pulsed output should be observed	Check Model 1107E/1108E only

SECTION IV

PARTS LIST

4-1. GENERAL.

4-2. Table 4-1 provides a listing of the hardware that mechanically connects the two components of the Model 1607E/1608E Signal Generator. The parts list, of the individual components of the Model 1607E/1608E are found in the individual instruction manuals of the components.

TABLE 4-1. PARTS LIST

Ref Symbol	Description	Manufacturer's Part No.	Mfrs Code	Qty
H1-H4	BRACKET	A165656	82199	4
	SCREW, MACHINE, PAN HEAD, CROSS-RECESSED, NO. 10-32 BY 1/2 IN. LG	MS35207-263	96906	12
	WASHER, FLAT, NO. 10	MS15795-808	96906	12
	WASHER, LOCK, NO. 10	MS35333-73	96906	12

POLARAD ELECTRONICS,INC.

5 Delaware Drive Lake Success,New York 11042 516-328-1100

REQUEST FOR MAINTENANCE

FROM:

COMPANY NAME _____ DATE: _____

ADDRESS: _____ INDIVIDUAL: _____

_____ POSITION: _____

_____ PHONE NO. _____ EXT. _____

_____

_____

SECTION OR DIVISION: _____

EQUIPMENT: _____ DATE OF PURCHASE: _____

MODEL _____ SERIAL NO. _____ ORDER NO. _____

_____

TROUBLE REPORT:

A. Description of trouble _____

_____

_____

_____

_____

_____

B. Has trouble been localized? _____ If so, how and where: _____

_____

_____

_____

_____

_____

C. Instruments used and measurements taken, if any: _____

_____

_____

_____

_____

D. Is trouble intermittent? _____

E. Hours of operation prior to this trouble _____

F. Date troubled occurred _____

G. Was factory consulted by telephone or letter prior to this request? _____

If so, give date and person to whom directed: _____

_____

H. Additional comments: _____

_____

_____

_____

_____

_____

_____

_____

When trouble develops requiring factory assistance, complete this form and send to:

Polarad Electronics, Inc.
5 Delaware Drive
Lake Success, New York 11042
Attn: Service Department

After this report has been analyzed by the Service Department, you will be notified when a field service engineer will call on you to make the necessary repairs. If your trouble can best be corrected at the factory, we will notify you with instructions and authorization for returning the equipment.

NO EQUIPMENT MAY BE RETURNED TO THE FACTORY WITHOUT WRITTEN AUTHORIZATION

INSTRUCTION MANUAL

MODULAR MICROWAVE SIGNAL GENERATORS MODELS 1107E AND 1108E

MODULAR MICROWAVE SIGNAL SOURCES MODELS 1207E AND 1208E

polarad polarad polarad **polarad**

Polarad Electronics, Inc. 5 Delaware Dr. Lake Success N.Y. 11042 Tel 516-328-1100 TWX 510-223-0414

OCTOBER 1980

Warranty

polarad electronics, inc.

We warrant each new instrument to be free of defects in materials and workmanship.

We will service, repair and adjust as required any instrument which proves defective within one year after date of delivery and which is returned to our factory (or other authorized depot) for that purpose.

For warranty information or other assistance, please contact Polarad Customer Service Department in Lake Success, New York, or an authorized regional service depot.

No other warranty is expressed or implied. No liability is assumed for consequential damages.

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SUPERSEDED MODELS

The new Polarad Models 1107E, 1108E, 1207E, and 1208E are direct replacements for earlier models. They are identical in form, fit, and function. The new models provide superior performance capability and with their solid state construction, greater reliability and simpler maintainability.

MODEL 1107E is a direct replacement for MODEL 1107A
MODEL 1108E is a direct replacement for MODEL 1108A
MODEL 1207E is a direct replacement for MODEL 1207A
MODEL 1208E is a direct replacement for MODEL 1208A

polarad

INSTRUCTION MANUAL CHANGE BULLETIN

THIS BULLETIN APPLIES TO:

MODEL(S): 1107E,1108E,1207E,1208E
ISSUE DATE: March 18,1981
SERIAL NO.: 1107E:5-101 & up
1108E:5-101 & up
1207E:2-101 & up
1208E:6-101 & up

Figure 5-6 High Voltage Control Board Assembly,A4, Schematic Diagram.
Add the following components,

1. Jump R28 with C14, 100(MF), 12vdcw, capacitor with - at the base of Q1.

2. Add C13 from the base of Q2 to ground. C13 is a 330(MF), 50 vdcw capacitor with + at the base.

Page 6-7,Table 6-2:

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	QTY
A4C13	Capacitor,Electrolytic, 330(MF), 50vdcw	VTL	37942	1
A4C14	Capacitor,Electrolytic, 100(MF), 12vdcw	Arcolytic ME4D100	84171	1

Table 6-1. Manufacturer's Code

84171	Arco Electronics 400 Moreland Rd. Commack, N.Y.

This bulletin should be carefully examined since it contains information vital for updating this manual and for incorporating changes made after publication date. Bulletins are issued to insure that the manual contains current information and reflects the characteristics of the instrument for which it is intended.

For additional information, please contact Polarad's instrument application specialists for maintenance assistance, or our Customer Service Department.

Polarad Electronics, Inc.
5 Delaware Drive / Lake Success, New York 11042 / 516-328-1100 / TWX 516-223-0414

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INSTRUCTION MANUAL CHANGE BULLETIN

THIS BULLETIN APPLIES TO:

MODEL(S): 1107E
SERIAL NO.:
ISSUE DATE: March 1981

Page 1-2, Table 1-2: Change as follows:

Characteristic	Specification
Output power absolute accuracy	1107E: ±2dB, 3.7 to 7.6 GHz* ±2.5 dB, >7.6 to 8.2 GHz*

This bulletin should be carefully examined since it contains information vital for updating this manual and for incorporating changes made after publication date. Bulletins are issued to insure that the manual contains current information and reflects the characteristics of the instrument for which it is intended.

For additional information, please contact Polarad's instrument application specialists for maintenance assistance, or our Customer Service Department.

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Figure 1-1. Modular Microwave Signal Generator Model 1108E

SECTION I

INTRODUCTION

1-1. SCOPE OF MANUAL.

1-2. This manual contains instructions for the use and maintenance of the Modular Microwave Signal Generators, Models 1107E and 1108E (figure 1-1), and Signal Sources, Models 1207E and 1208E manufactured by Polarad Electronics Inc., Lake Success, New York. The manual includes a general description of the instruments, operating instructions, theory of operation, maintenance data, and a parts list.

1-3. PURPOSE AND USE OF INSTRUMENTS.

1-4. SIGNAL GENERATORS, MODELS 1107E AND 1108E. The frequency range of Model 1107E is 3.70 to 8.40 GHz and the frequency range of Model 1108E is 6.95 to 11.0 GHz. The ratings for uncalibrated power output for Model 1107E are at least 10 mw from 3.7 to 7.6 GHz, and at least 5 mw from 7.6 to 8.4 GHz. The Model 1108E provides uncalibrated power outputs of at least 10 mw from 6.95 to 11.00 GHz. The range of the calibrated attenuator is typically +3 to –127 dBm with an absolute accuracy of ±2 dB. Typically more than rated power is available. However, when the ATTENUATOR control is adjusted for more than the rated output levels, it is possible to overcouple the pickup probe, causing minor frequency shifts and, with excessive overcoupling, reduction of power output.

1-5. Typical uses of the Signal Generators are testing broad- and narrow-band microwave systems and components such as amplifiers, antennas, attenuators, beacons, crystal mounts, hybrid junctions, preselectors, radars and receivers. These instruments can also be used to make specific measurements of bandwidth, attenuation, frequency dial calibration, image rejection, sensitivity, power gain, VSWR and other characteristics. They can also be used as a receiver local oscillator, modulated transmitter, or system microwave reference in checkout equipment.

1-6. SIGNAL SOURCES, MODELS 1207E AND 1208E. The models 1207E and 1208E Signal Sources provide a maximum power output over their frequency ranges as shown in figure 1-2. The Signal Sources differ from the Models 1107E and 1108E Signal Generators in that their attenuators are not calibrated and their output impedances are very low. The frequency ranges of the Signal Sources are identical with those of the corresponding Models 1107E and 1108E Signal Generators.

1-7. Typical uses of the Signal Sources are in the investigation of antenna patterns and characteristics, measurement of attenuation, gain, insertion loss, Q, selectivity, frequency, and signal-to-noise ratio. They can also be used for alignment of communication and radar systems and components. When either Signal Source is used with the appropriate Frequency Doubler (Models 1509 and 1510, respectively), the combination provides all facilities of a signal generator at double the Signal Source frequency. See Table 2-2 for frequency coverage.

1-8. The Modular Microwave Signal Generators, Models 1107E and 1108E, and Signal Sources, Models 1207E and 1208E, incorporate phase lock provisions to increase their frequency stability when used with an external oscillator synchronizer.

1-9. The Modular Microwave Signal Generators, Models 1107E and 1108E and Signal Sources, Models 1207E and 1208E, incorporate provisions for external motor drive. The tuning shaft extends through the rear of the instruments for this purpose.

1-10. GENERAL DESCRIPTION.

1-11. The Modular Microwave Signal Generators, Models 1107E and 1108E, and Signal Sources, Models 1207E and 1208E, which hereafter will be referred to by model number, are identically-sized, self-contained, compact instruments suitable for bench or rack use. The instruments are line-powered and consist of a panel, a frame or chassis, and dust covers. The panel serves as a mounting for the controls, connectors, and power level monitoring meter (1107E and 1108E only). The handles at either end of

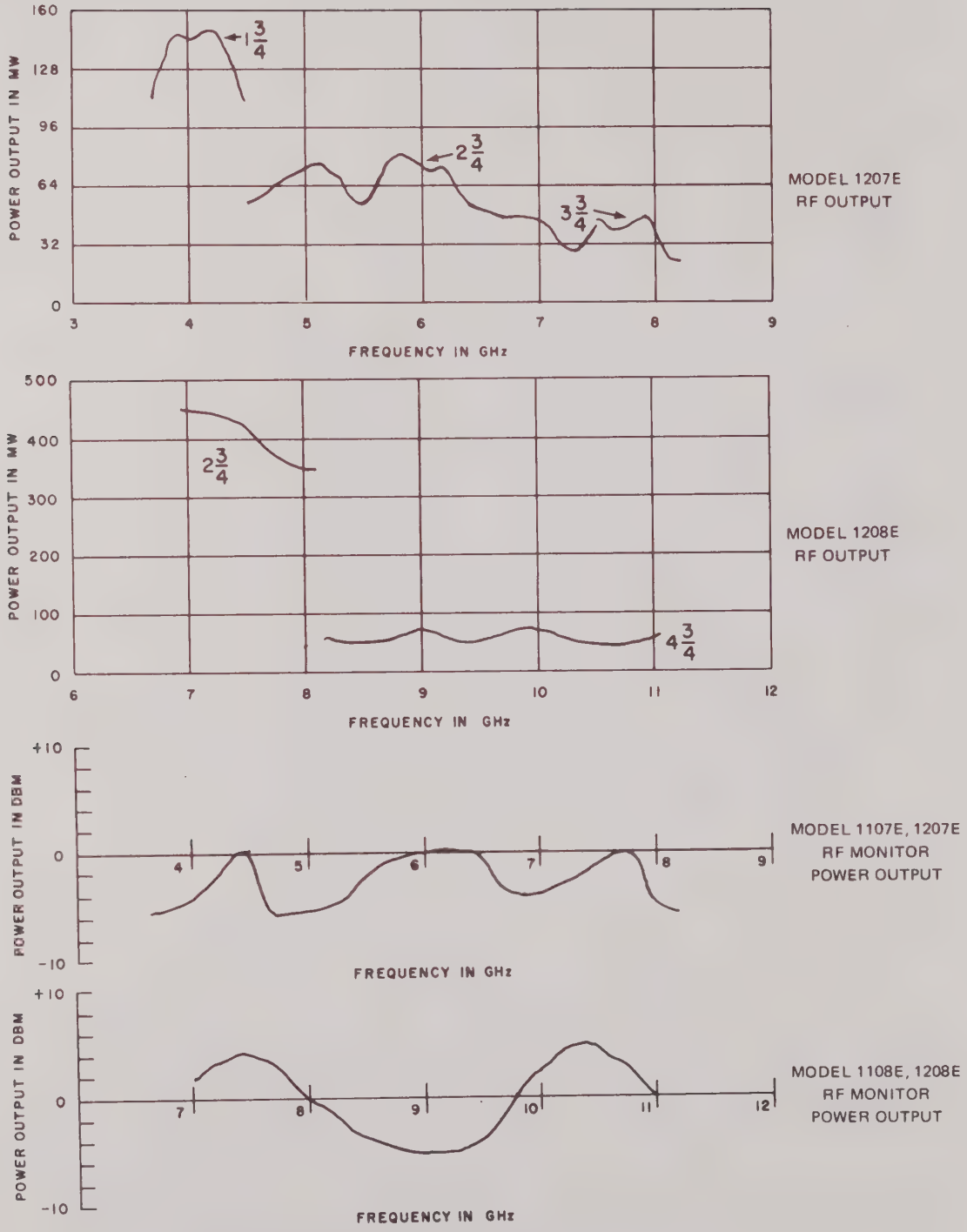


Figure 1-2. Typical RF Outputs and RF Monitor Power Outputs.

the panel are reversible for bench or rack use. The dust covers, which are side, top, and bottom panels, enclose and protect the internal components of the instrument.

1-12. EQUIPMENT SUPPLIED.

1-13. Table 1-1 lists the equipment supplied for the Models 1107E, 1108E, 1207E, and 1208E instruments.

1-14. EQUIPMENT SPECIFICATIONS.

1-15. Table 1-2 lists the equipment specifications for the Models 1107E, 1108E, 1207E, and 1208E instruments.

1-16. TRANSISTORS, DIODES, INTEGRATED CIRCUITS AND KLYSTRON COMPLEMENT

1-17. Table 1-3 lists the transistors, diodes, integrated circuits, and klystron complement of Models 1107E, 1108E, 1207E, and 1208E.

1-18. ACCESSORIES FOR POLARAD SIGNAL GENERATORS AND SOURCES.

1-19. The **Polarad Model 1020A Modulator** is a solid state function generator which provides adjustable, well-defined, precise pulses, square wave, and sawtooth waveforms for pulse, FM, and square wave modulation. It is a valuable accessory for the 0.80-21 GHz Series 1100 Signal Generators and Series 1200 Signal Sources. It can also be used with many other instruments. The repetition rates of all output waveforms are adjustable from 10 to 10,000 Hz. Pulse widths are adjustable from 0.2 to 2000 microseconds. The linear sawtooth output is adjustable in amplitude to vary FM deviation. The 1020A Modulator can be synchronized internally, or externally by positive pulses, negative pulses, or sine waves. Sharp 25 volt sync pulse outputs are also generated. Sync outputs are available undelayed and delayed, from two output terminals. The delay is adjustable from 0.3 to 2000 microseconds. The compact Polarad Model 1020A Modulator is provided in a 1-3/4" high modular cabinet which permits convenient rack mounting or stacking with other modular units of this series of Polarad instruments. Four side mounting brackets are supplied for rigid attachment to any companion Polarad instruments. When the top cover is removed, all parts are available for accessibility and ease of servicing. Dimensions: 1-3/4" H x 16-3/4" W x 16-3/8" D.

1-20. An external frequency stabilizer can be used to phase lock the output frequency of Polarad Microwave Signal Generators and Sources, as well as with other instruments. Short term stability is rated at 0.8 Hz per GHz per millisecond. Long term stability of 10 Hz per GHz per hour is achieved during continuous operation in typical laboratory environments. The crystal controlled reference oscillator is mounted within a proportional temperature compensating oven. Dimensions: 5-1/4" H x 16-3/4" W x 17" D.

1-21. The **Klystron Cap Extender, Part No. B160465,** separates the klystron cap from the oscillator cavity during frequency alignment. Klystron rotational alignment is simplified when the extender is used.

1-22. The **Generator Test Set MK-2** is used to check the initial parameters of the Generators/Sources. MK-2 is extremely useful for troubleshooting and aligning of the electronics of Generators/Sources.
Additional technical and ordering information available upon request from:

Polarad Electronics, Inc.
5 Delaware Drive
Lake Success, New York 11042

TABLE 1-1. EQUIPMENT SUPPLIED

Name	Polarad Model or Part No.	Name	Polarad Model or Part No.
Modular Microwave Signal Generator	1107E (1) 1108E (1)	Instruction Manual	
		Power Cable	B160833
Modular Microwave Signal Source	1207E (1) 1208E (1)	Spanner Wrench	AP15550
		Test Connector	A713772
RF Cable Assembly	B12551		

1. Either one.

TABLE 1-2. EQUIPMENT SPECIFICATIONS

Characteristic	Specification	
Frequency range	1107E/1207E: 3.70 to 8.40 GHz 1108E/1208E: 6.95 to 11.0 GHz	
Frequency accuracy	±0.5% (digital readout)	
Frequency stability	0.0008%/volt change in line, 0.005%/°C ambient	
ΔF control	Range of 1.5 MHz minimum	
Rated uncalibrated power output	1107E:	⩾ 10 mw from 3.7 to 7.6 GHz ⩾ 5 mw from 7.6 to 8.4 GHz
	1108E:	⩾ 10 mw from 6.95 to 11.0 GHz
	1207E:	⩾ 60 mw from 3.7 to 4.3 GHz ⩾ 25 mw from 4.3 to 5.0 GHz ⩾ 55 mw from 5.0 to 6.6 GHz ⩾ 25 mw from 6.6 to 8.4 GHz
	1208E:	⩾ 75 mw from 6.95 to 8.00 GHz ⩾ 30 mw from 8.00 to 11.0 GHz
Attenuator range	1107E/1108E:	+6 dBm (0.310 volts) to −130 dBm (0.1 microvolts)
Output power absolute accuracy	1107E:	±2 dB (+3 dBm to −127 dBm), 3.7 to 8.2 GHz *
	1108E:	±2 dB (+3 dBm to −127 dBm), 6.95 to 11.0 GHz *
Output impedance	1107E/1108E:	50 ohms, nominal
Output VSWR	1107E/1108E:	2:1 maximum
Types of output available	CW, square wave, or fm, without external modulation	
Internal square wave:		
Rate	1000 ± 5% Hz, minimum	
On-off ratio	Infinite	
Synchronization	Internal	

* When power monitor meter is set to CAL

TABLE 1-2. EQUIPMENT SPECIFICATIONS (Cont'd)

Characteristic	Specification
Internal fm:	
Rate	Power line frequency
Sweep Width	Continuously adjustable from 0 to 10 MHz, typical
Horizontal sweep output for scope time base	2 volts p-p min., power line frequency
Phase control range	Adjustable to 90°, minimum
External pulse modulation:	(Polarad Model 1020A recommended)
Level	Positive polarity, 15 to 50 volts peak
Rate	Single pulse to 100 kHz
Width of output pulses	0.2 to 2,500 microseconds
Rise time of output pulses	1107E/1207E: ⩽ 0.15 microseconds
	1108E/1208E: ⩽ 0.10 microseconds
Decay time of output pulses	1107E/1207E: ⩽ 0.15 microseconds
	1108E/1208E: ⩽ 0.10 microseconds
External fm modulation:	
Type and rate	Any waveshape having frequency components between 10 Hz and 0.5 MHz
Sweep width	Adjustable from 0 to 10 MHz,typical
RF monitor output	>−10 dBm
Power requirements	115 or 230 volts ± 10%, 50-60 Hz, 140 watts (50 to 400 Hz range optional, F option)
Dimensions	5¼"(13.4 cm) H x 16¾"(42.5 cm) W x 18¼"(47.1 cm) D
Weight	44 pounds (20 kg)

TABLE 1-3. TRANSISTORS, DIODES, INTEGRATED CIRCUITS, AND KLYSTRON COMPLEMENT

Quantity	Description	Type No.	Quantity	Description	Type No.
2	RECTIFIER, BRIDGE	MDA 970-1	1	TRANSISTOR	2N4402
2	DIODES, ZENER	1N4742A	1	TRANSISTOR	2N4400
9	DIODES	1N456	3	TRANSISTOR	MJE3055T
1	DIODE	EG300	2	TRANSISTOR	2N5988
5	DIODE, ZENER	1N4751A	1	Integrated circuit, voltage regulator	UA78-GU1C
1	DIODE	1N914	1	IC, Schmitt Trigger	CD40014P
2	DIODES, ZENER	1N5281B	1	IC, Dual D-type Flip-Flop	CD4013AE
1	DIODE, ZENER	1N5281B	2	IC, TIMER-OSCILLATOR	SN72555P
1	RECTIFIER, BRIDGE	MDA 920A-3	1	IC, fixed voltage regulator	MC78M20CP
8	DIODES, FAST SWITCHING HIGH VOLTAGE RECTIFIER	SH30F	1	IC, precision voltage regulator	SN 72723L
1	DIODE, ZENER	1N4759A	1	IC, Op-Amp.	SN72741L
1	TRANSISTOR	D40E7	1	KLYSTRONS	A160011A*, A160034**, A160035***
2	TRANSISTOR.	2N5415			

*Used in Models 1107E and 1207E only.
**Used in Model 1108E only.
***Used in Model 1208E only.

SECTION II

OPERATION

2-1. GENERAL.

2-2. Models 1107E, 1108E, 1207E, and 1208E are shipped complete and ready to operate; no special or permanent installation procedures are required. The instrument should be unpacked upon receipt, observing the usual precautions customary when unpacking an electronic instrument.

2-3. INSTALLATION.

2-4. After unpacking the instrument, plan its installation. If it will be used on a bench or cart, the required space is shown in figure 2-1. If it will be mounted in a rack, the handles at either end of the panel should be reversed as shown in figure 2-1 for rack mounting. The instrument requires 115 or 230 volts, single phase, 50-60 Hz ac power.

Note

Models 1107E, 1108E, 1207E, and 1208E are shipped ready for 115-volt operation. If the instrument will be operated from a 230-volt source, set the 115/230 volt switch in the rear to the 230-volt position and change fuse to 0.75 amp. The location of the switch is shown in figure 2-2.

2-5. Connect power line cord B160833 to ac input of the instrument and then into an ac power source.

2-6. OPERATING PROCEDURES.

2-7. The operating procedures for Models 1107E, 1108E, 1207E, and 1208E are described in paragraphs 2-8 through 2-14.

2-8. OPERATING CONTROLS, INDICATORS, AND CONNECTORS. The operating controls, indicators, and connectors of the instrument are shown in figure 2-2, and their functions are listed in table 2-1.

2-9. CONNECTION AND PRELIMINARY OPERATION. To operate Models 1107E, 1108E, 1207E, and 1208E, proceed as follows:

a. Connect instrument to device under test and external modulation source, if required, as shown in figure 2-3.

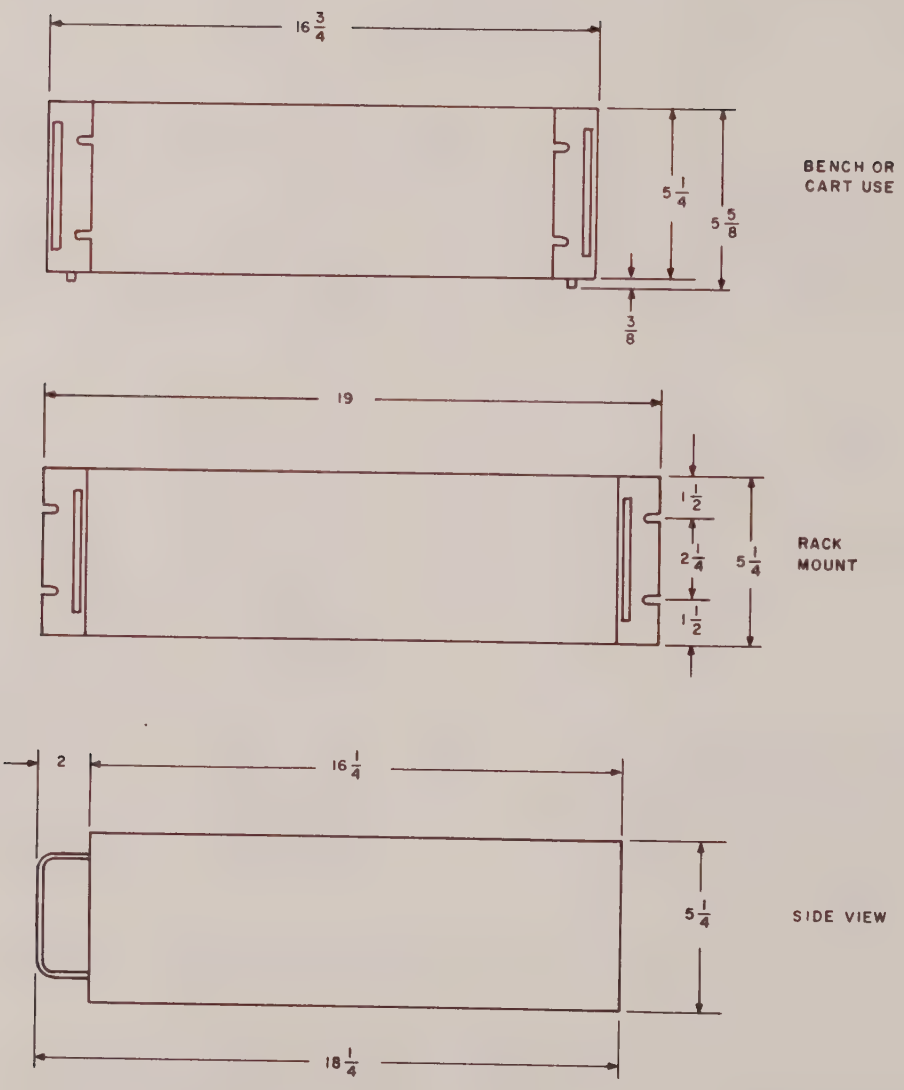
CAUTION

During the initial operation of the unit, the ΔF control should be set at "0." It is used for fine frequency adjustment up to 1.5 MHz. Caution should be exercised, however, when offsetting the ΔF control. At some frequencies, its range is so great that the oscillator mode may be shifted by excessive ΔF rotation. This effect may result in large frequency shifts that may appear to be a loss of signal or jump in frequency in equipment under test. For normal operation, return the ΔF control to "0" and limit the ΔF rotation as required. The lower frequency range of Models 1107E and 1207E between 3.7 to 4.0 GHz, is particularly sensitive to excessive ΔF rotation.

b. Set POWER switch to ON and allow the instrument to warm up for 15 minutes.

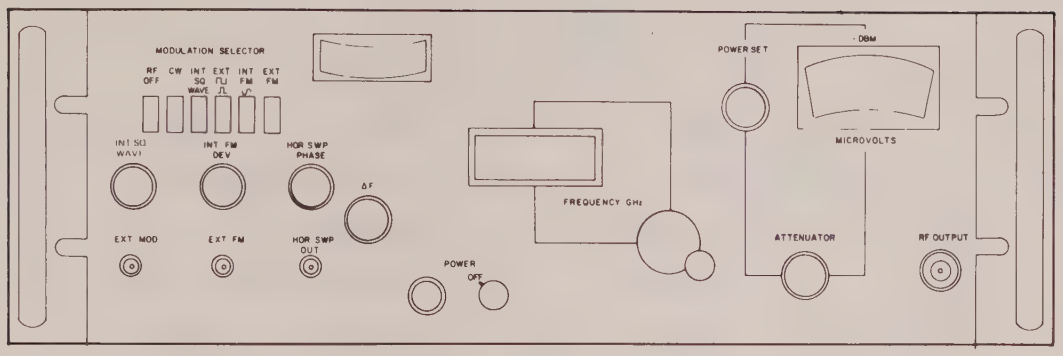
c. Tune the frequency control for a readout of the desired frequency on the FREQUENCY GHz dial.

d. On Models 1107E and 1108E only, set the MODULATION SELECTOR switch to CW position and adjust the POWER SET control for a power monitor meter indication of CAL.

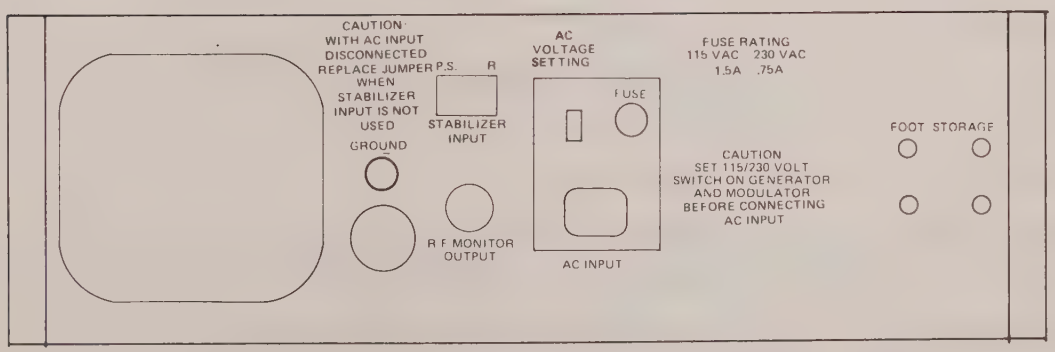


Note: All dimensions are in inches.

Figure 2-1. Models 1107E, 1108E, 1207E, and 1208E. Outline Installation Drawings



FRONT PANEL



REAR PANEL

Figure 2-2. Operating Controls, Indicators, and Connectors

TABLE 2-1. OPERATING CONTROLS, INDICATORS, AND CONNECTORS

Controls, Indicators, and Connectors	Function
POWER switch	Controls application of ac power
Power indicator lamp	Lights when power is applied to instrument
MODULATION SELECTOR pushbutton switch	Selects type of modulation as follows: RF OFF . . . . . Disables rf output; standby position CW . . . . . No modulation present INT SQ WAVE . . . . . Internal square wave modulation EXT ⊓⊔⊓ . . . . . External square wave or pulse modulation INT FM ~ . . . . . Internal FM line frequency modulation EXT FM . . . . . External FM modulation
INT SQ WAVE control	Adjusts square wave frequency over the range of 950 to 1050 Hz minimum
INT FM DEV control	Adjusts amplitude of interal fm driving signal
HOR SWP PHASE control	Controls phase of horizontal sweep signal to oscilloscope
EXT MOD connector	Accepts external pulse or square wave modulation signal
EXT FM connector	Accepts external fm signal
HOR SWP OUT connector	Output for horizontal sweep signal to oscilloscope
FREQUENCY GHz dial	Displays digital frequency readout
Frequency control	Adjusts instrument frequency
ΔF control	Fine frequency control. May be used to maximize system power output, control pulse jitter, and center FM sweep
ATTENUATOR control	Adjusts power level of instrument
RF OUTPUT connector	Available RF power
POWER SET control**	Used to adjust oscillator power level for power monitor meter indication of CAL
Attenuator dial**	Displays readout in dBm and microvolts of attenuator output at the RF OUTPUT connector when power meter is set to CAL
Power monitor meter**	Used to set power level of instrument for attenuator calibration
RF MONITOR OUTPUT connector*	Used for automatic frequency stabilization or auxiliary RF OUTPUT
STABILIZER INPUT terminals*	Used for automatic frequency stabilization
AC INPUT connector*	Power cord input
115/230V selector switch*	Selected according to ac voltage of power source
FUSE*	Protects instrument from damage

*Located on rear panel.
**Model 1107E and 1108E only.

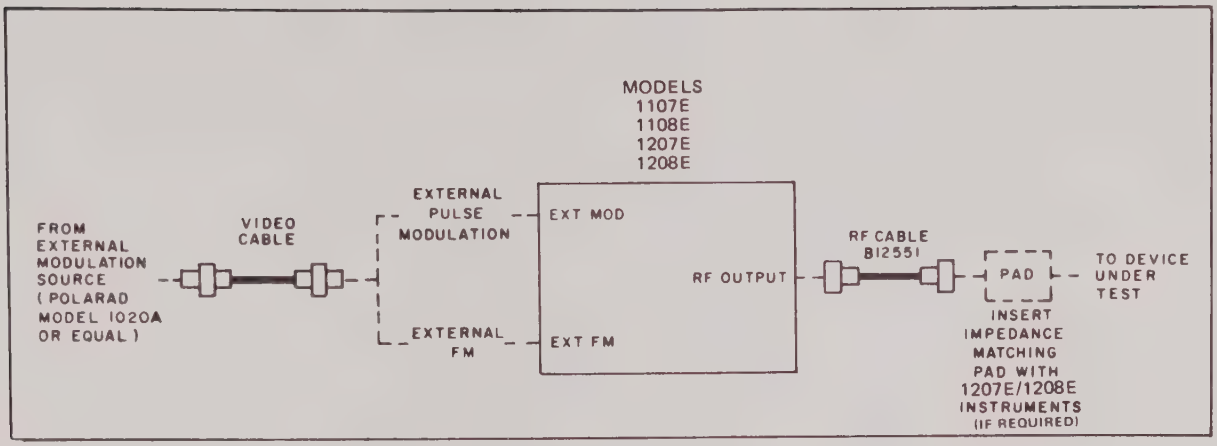


Figure 2-3. Models 1107E, 1108E, 1207E, and 1208E. Connections for Use

Note

The power monitor meter is graduated from -3 to +3, with the CAL marking midway between the extremes. If the POWER SET control is adjusted to obtain an indication other than CAL, the indication of the power monitor meter should be algebraically added to the reading of the attenuator dial. For example, if the power monitor meter reads -2 and the attenuator dial is set at -56 dbm, the power level at the RF OUTPUT connector would be -58 dbm.

e. On Models 1107E and 1108E only, adjust the ATTENUATOR control for the desired power output level at the RF OUTPUT connector. If required, correct the reading of the attenuator dial for power monitor meter readings other than CAL, as described in the preceding note.

Note

Use of the 6 db range of the power monitor meter provides an additional 3 db at each end of the power output range, giving an overall range from +6 dbm to -130 dbm.

f. On Models 1207E and 1208E, set the MODULATION SELECTOR switch to CW and adjust the ATTENUATOR control for the desired power output level at the RF OUTPUT connector. There is no attenuator dial on these models.

g. To operate Models 1107E and 1108E at another frequency, perform steps c, d, and e.

h. To operate Models 1207E and 1208E at another frequency, perform steps c and f.

Note

The ΔF control provides a frequency vernier with a minimum range of 1.5 MHz. Always reset to "0" when not used.

i. To place the set on stand-by; set the MODULATION SELECTOR switch at RF OFF.

2-10. CW OPERATION (1107E, 1108E, 1207E, 1208E). For CW operation proceed as follows:

a. Set the FREQUENCY GHz control to the desired frequency.

b. Depress the CW button on the MODULATION SELECTOR switch. In this mode, the INT SQ WAVE and INT FM DEV controls have no effect.

CAUTION

It is possible to make Signal Generators/Sources inoperative by driving the attenuator probe too far into the oscillator cavity of the Signal Generator/Source. If this occurs, back off the attenuator by turning the ATTENUATOR control counter clockwise for Models 1107E and 1108E and clockwise for Models 1207E and 1208E. Set the MODULATION SELECTOR switch to RF OFF and repeat steps a and b of paragraph 2-10.

c. Set the ΔF control to "0."

d. Adjust the POWER SET control for a reading of CAL on the power meter.

e. Connect RF OUTPUT to unit under test.

f. Adjust the ATTENUATOR control for the desired output on the attenuator dial.

2-11. INTERNAL SQUARE WAVE MODULATION OPERATION (1107E, 1207E, 1108E, 1208E). For internal square wave modulation, perform steps a through f of paragraph 2-10.

Depress the INT SQ WAVE button on the MODULATION SELECTOR switch and adjust the INT SQ WAVE control for the desired square wave frequency.

2-12. INTERNAL FM OPERATION (1107E, 1108E, 1207E, 1208E). For internal fm operation, perform steps a through f of paragraph 2-10.

a. Depress the INT FM ~ button on the MODULATION SELECTOR switch.

b. Adjust the INT FM DEV control to obtain the desired sweep width.

Note

To obtain maximum FM deviation, it may be necessary to vary the ΔF control.

c. To observe frequency reponse of a component or system under test proceed as follows:

(1) Feed the RF OUTPUT signal through a frequency meter to the unit under test.

(2) Feed the detected output to the vertical input of an oscilloscope.

(3) The HOR SWP OUT is fed to the horizontal amplifier input of the oscilloscope.

(4) Set the vertical and horizontal gain of the oscilloscope for full scale deflection.

(5) Adjust the INT FM DEV control so that the FM deviation is sufficient to observe the frequency response.

(6) Adjust the HOR SWP PHASE control so that the forward and reverse sweeps are overlapped.

(7) Adjust the frequency meter to measure the frequency response by observing the pip from one end of the response to the other.

2-13. EXTERNAL FM OPERATION (MODELS 1107E, 1108E, 1207E, 1208E). For external fm operation, perform steps a thorugh f of paragraph 2-10.

a. Connect the modulation source to the EXT FM connector.

Note

Polarad Models 1020A and 1020-T Modulators are recommended for external pulse, FM, and square wave modulation.

b. Depress the EXT FM button on the MODULATION SELECTOR switch.

2-14. EXTERNAL PULSE/SQUARE WAVE OPERATION. For external pulse/square wave operation, perform steps a through f of paragraph 2-10 and proceed as follows:

a. Connect the modulation source to the EXT MOD connector.

b. Depress the EXT ⊓⊔ ⊓button of the MODULATION SELECTOR switch.

TABLE 2-2. MODULAR MICROWAVE INSTRUMENT COMBINATIONS

Signal Source	Signal Generator	Frequency Doubler	Modulator	Capabilities
–	1107E	*	1020A	1107E range with full modulation capabilities (Model 1607E)
–	1108E	*	1020A	1108E range with full modulation capabilities (Model 1608E)
1207E	–	1509	–	10.0-15.5 GHz range (Model 1709E)
1207E	–	1509	1020A	10.0-15.5 GHz range with full modulation capabilities (Model 1809E)
1208E	–	1510	–	15.0-21.0 GHz range (Model 1710E)
1208E	–	1510	1020A	15.0-21.0 GHz range with full modulation capabilities (Model 1810E)

*Models 1107E and 1108E can be used with Frequency Doublers Models 1509 and 1510 respectively. The power output will be somewhat less than provided by the Signal Sources Models 1207E and 1208E with the Doublers. Contact Polarad for additional information.

Note

At some frequency settings, it is advisable for most stable pulse modulation to adjust the ΔF control. A detector and an external oscilloscope can be used to display the detected output pulse.

2-15. AUTOMATIC FREQUENCY STABILIZATION. Models 1107E, 1108E, 1207E, and 1208E include provisions for automatic frequency stabilization to better than 10 Hz, with the degree of stabilization being dependent on the gain and stability of the external control system used. The input of the phase- or frequency-control system used is connected to RF MONITOR connector at the rear of the instrument and the output of the control system is connected to the STABILIZER INPUT terminals, also at the rear of the instrument.

2-16. OPERATION WITH OTHER MODULAR MICROWAVE INSTRUMENTS. In addition to the individual use of the Signal Generators and Sources, they can be grouped with other instruments in the Modular Microwave series to extend their capabilities. Table 2-2 lists some of the possible combinations and their capabilities. Models 1020A, 1207E, and 1509 can be stacked to form Model 1809E with frequency ranges of 3.7 to 8.4 GHz and 10.0 to 15.5 GHz and full modulation capability.

2-17. PACKAGING INSTRUCTIONS.

2-18. PACKAGING FOR SHORT TERM STORAGE. If the instrument is to be stored for a relatively short period, cover it with a suitable protective covering, such as a sheet of plastic or paper. Put the accessories and instruction manual in an envelope or bag and fasten it to the instrument to prevent loss. Store the instrument in a clean and dry area where it will not be subjected to extreme temperatures.

2-19. PACKAGING FOR LONG TERM STORAGE OR SHIPMENT. (See figure 2-4.) If the instrument is to be stored for a long time or shipped, proceed as follows:

a. Save the original wrappings and carton and repackage the instrument in them. The original packing material properly cushions the instrument for shipment.

b. If the original packing has not been saved, call Polarad Electronics Inc. for proper shipping instructions.

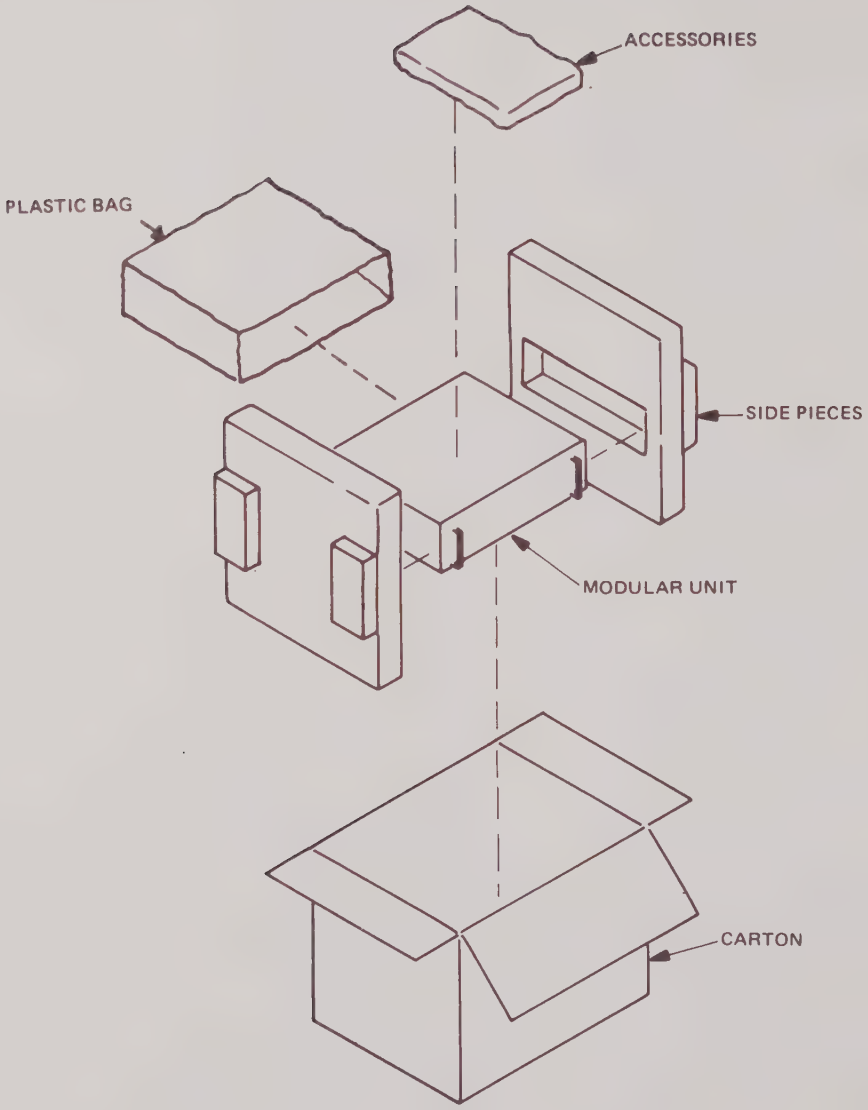


Figure 2-4. Packaging Diagram

SECTION III

THEORY OF OPERATION

3-1. GENERAL.

3-2. The Modular Microwave Signal Generators and Sources, Models 1107E, 1108E, 1207E, and 1208E, are signal-generating devices that employ klystron oscillators with external cavities to generate rf energy. The signal generator models, 1107E and 1108E, have calibrated attenuators and 50-ohm output impedance; the signal source models, 1207E and 1208E, have uncalibrated attenuators and a low reactive output impedance. The signal generators and sources have identical principles of operation, differing only in attenuator calibration and power monitoring, output impedance, and output power level. The 1107E and 1108E have a maximum calibrated power output of +3 dbm (0.310 volts), and the 1207E and 1208E have a power output of at least 25 milliwatts. The frequency ranges of the generators and sources are listed below.

Models	Range, GHz
1107E, 1207E	3.7 to 8.4
1108E, 1208E	6.95 to 11.0

3.3 The ensuing theory of operation coverage will be for all four models (1107E, 1108E, 1207E, 1208E), except where specific model reference is made.

3-4. BLOCK DIAGRAM ANALYSIS.

3-5. The Signal Generators and Sources, shown in block diagram form in figure 3-1, consist of eight principal circuit elements: a klystron oscillator, its repeller tracking system, a beam power supply, a repeller power supply, a 40V power supply for modulation circuits, a Schmitt trigger, a square wave generator and an amplifier circuit. The klystron oscillator employs a reflex klystron tube that is mounted into an external coaxial cavity, which is tuned to resonance by a non-contacting short tuning plunger driven by the FREQUENCY GHz control. The frequency drive system also operates the digital readout frequency dial and the tracking system, which selects the proper repeller mode and adjusts the repeller voltage for the frequency selected. The power supplies are completely solid-state using monolithic linear integrated circuits as precision voltage regulators. The Schmitt trigger followed by the amplifier delivers the square wave and pulses to the klystron oscillator. The square wave generator is a D-type Flip Flop(A3A1U4) whose variable frequency is controlled by the timer A3A1U3 from 950 to 1050 Hz, minimum.

3-6. Models 1107E and 1108E incorporate a power monitoring circuit that enables the attenuator to be calibrated directly in dBm and microvolts. The power set drive system moves the power probe and the hairline of the attenuator dial. The power monitor probe couples rf power from the klystron cavity to the crystal detector and power monitor meter. When the POWER SET control is adjusted for a power monitor indication of CAL, the power monitor probe is coupled to approximately 1 milliwatt power level. The ATTENUATOR control operates the attenuator probe and the dBm-microvolts dial to provide a calibrated rf output.

3-7. Models 1207E and 1208E incorporate an uncalibrated output attenuator. The attenuator control operates the attenuator probe, which couples rf power from the klystron cavity to the rf output connector.

3-8. The Signal Generators and Sources incorporate a provision for automatic frequency stabilization. A sample of power in the klystron oscillator is fed to an external control system and the output of the external control system is fed to the klystron repeller as a correction voltage which is superimposed on the repeller voltage.

3-9. DETAILED THEORY OF OPERATION (See Figures 3-1, 5-1 thru 5-7)

3-10. KLYSTRON OSCILLATOR. A klystron oscilator, VI provides the rf power output. It is velocity-modulated, operating in an external resonant coaxial transmission line and consists of two conductors, one inside the other.

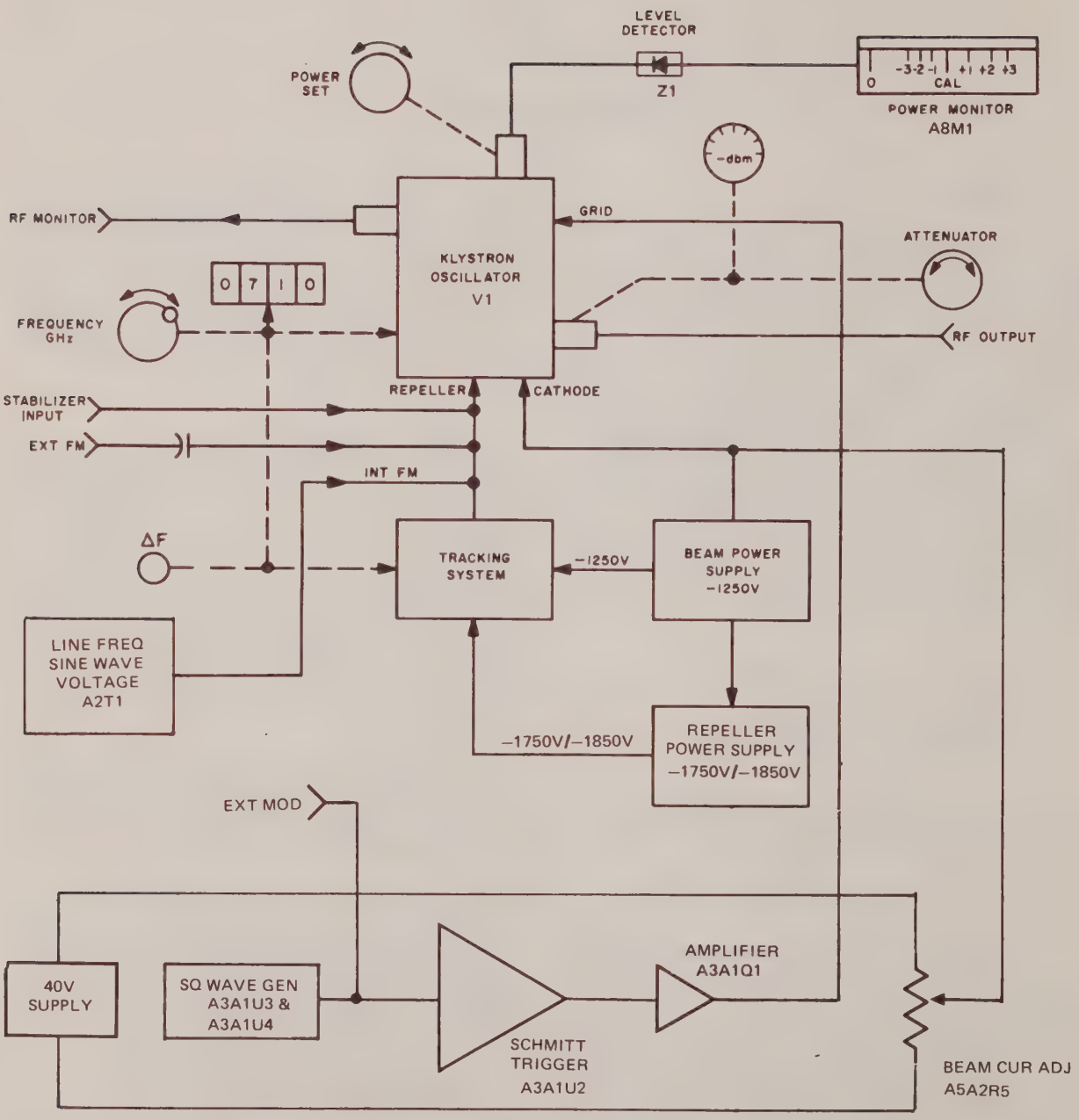


Figure 3-1. Modular Microwave Signal Generators/Sources (Models 1107E, 1108E, 1207E, and 1208E) Block Diagram

The klystron is mounted at one end of the cavity with the outer cylinder making contact with the first grid and the inner conductor making contact with the second resonator grid. The resonant circuit is completed at the other end of the cavity by a moveable non-conducting shorting plunger. The position of this plunger determines the resonant frequency of the cavity.

3-11. The frequency of oscillation of the klystron oscillator is determined by the resonant frequency of the cavity and the magnitude of the repeller voltage. For a given setting of the cavity, there is an optimum repeller voltage that will cause the bunched electrons to return to the resonator grids at the proper time. The repeller voltage, therefore, cannot remain the same over the frequency range of the oscillator. In order to produce oscillation over the frequency range of the oscillator, a tracking arrangement is used to vary the dc voltage on the repeller so that it is maintained at the optimum value for a given plunger setting. The required voltage ranges as a function of frequency, are shown in Figures 4-6 and 4-7.

3-12. MODE SWITCHING. At a certain frequency value (4.40 and 7.52 GHz for Models 1107E and 1207E, 8.15 GHz for Models 1108E and 1208E, approximately) the repeller voltage becomes excessively high and it is more practical to change the repeller voltage to a new range. This can be done without changing the frequency of oscillation at a given cavity setting by lowering the repeller voltage so that the tube operates in a higher mode. In the higher mode the bunched electrons require a longer time in cycles to be returned to the resonator grids. Models 1107E and 1207E operate in the 1¾, 2¾, and 3¾ modes, Models 1108E and 1208E operate in the 2¾ and 4¾ modes. The switching arrangement is described in paragraph 3-15.

3-13. The oscillator cavity is coupled through two probes; the attenuator probe with a variable amount of insertion that determines the rf power level delivered to the RF OUTPUT connector, and the fixed rf monitor probe that supplies the power sample for automatic frequency stabilization.

3-14. Models 1107E and 1108E incorporate a third power monitor probe, with a variable amount of insertion, that supplies power to the monitoring circuit for calibrating the output attenuator.

3-15. REPELLER VOLTAGE TRACKING SYSTEM. The dc voltage applied to the repeller is controlled by tracking potentiometer A7R1. The movement of the arm of A7R1 is mechanically ganged with the movement of the tuning plunger in the klystron cavity so that the repeller voltage is maintained at the optimum value for the maximum amplitude of oscillation. Repeller mode switch A7S1 (and A7S2 in Models 1107E/1207E) is operated by a cam driven by the tuning drive and changes the voltage applied to A7R1 so that a different mode can be used. The values of the resistors in the tracking circuit are calculated for the proper frequency-vs-voltage characteristic. Adjustment potentiometers are provided in the tracking circuit to compensate for variation in klystron repeller voltage characteristics. The maximum voltage across tracking potentiometer A7R1 is 500/600 v. since it is connected from the −1250 volt beam supply to the −1750/−1850 volt repeller supply. The cathode of klystron V1 is connected to the −1250 volt beam supply and therfore the repeller voltage can vary from 0 to −500/−600 volts.

Note

The ΔF control A3A2R28 provides a small variation in the repeller voltage, which produces a vernier frequency variation of at least 1.5 MHz.

3-16. PROTECTIVE DIODE. Protective diode A3A1CR4 is connected between the cathode and repeller of klystron V1 to prevent the repeller from becoming more positive than the cathode which would damage the klystron.

3-17. FREQUENCY CONTROL KNOB. The frequency control knob rotates the shaft which drives the digital readout, the cam that positions the tuning plunger, and the tracking potentiometer, each through the appropriate gearing. The shaft extends through the tuning mechanism casting to the rear of the instrument where it can be attached to an external motor drive, if required.

3-18. CALIBRATED ATTENUATION OPERATION. Power from the klystron cavity is coupled through two symmetrical pipes into two matched waveguide-beyond-cutoff attenuators. The POWER SET (Models 1107E and 1108E only) control positions the power set probe in its pipe. The power set probe couples rf power from the klystron cavity to the crystal detector and the power monitor meter and also moves the hairline of the attenuator dial. When the POWER SET (Models 1107E and 1108E) control is adjusted for a power monitor meter indication of CAL, the power set probe is coupled to

approximately 1 milliwatt power level. Should the energy level within the cavity change when the cavity is tuned to a different frequency, the power set probe must be reset to obtain the 1 milliwatt level of power absorption which will bring the power monitor meter back to its reference CAL position. At the same time, the hairline is repositioned to a new 0 dBm reference.

3-19. When the POWER SET (Models 1107E and 1108E) adjustment is set for CAL, the attenuator probe is adjusted for 0 dBm output at the same time that the attenuator dial is adjusted for 0 dBm under the hairline. In this way, as frequency is varied, and the power monitor meter is set for CAL by placing the attenuator dial at 0 dBm under the hairline, the output will be 0 dBm within the specification accuracy.

3-20. In order to obtain other levels of power, the ATTENUATOR control is adjusted so that the desired level is under the hairline of the attenuator dial. This adjustment varies the position of the attenuator probe in its waveguide-beyond-cutoff pipe. The rate of attenuation within the pipe follows a rigid physical law and is extremely accurate, thus the rate of attenuation is transcribed into the dial.

3-21. SCHMITT TRIGGER AND AMPLIFIER. The Schmitt trigger A3A1U2 is a gate with fast rise and decay times. The positive voltage to A3A1U2 is held at +12 volts and the negative supply at ground using dropping resistor A3A1R13 and zener diode A3A1CR1. The ground is referenced at -1270V. Diodes A3A1CR2 and A3A1CR3 act as protective diodes for A3A1U2 and A3A1C15 is a speed up capacitor to handle fast pulses. The input to the gate (pin 1) is held at +12V in the CW, INT FM and EXT FM positions and at ground (-1270 volts) in the RF OFF, INT SQ WAVE and EXT⊓ ⊔ positions via the MODULATION SELECTOR switch (see paragraph 3-24 for more details). The output of the gate (pin 2) is amplified by transistor A3A1Q1 to a suitable level so that the grid of the klystron is biased properly for different modes of operation. In the amplifier circuit A3A1CR5 is a protective diode for A3A1Q1, and A3A1C14 is a speed up capacitor. The amplifier itself acts as an inverter, and the gate A3A1U2 also acts as an inverter; therefore, the logic output of A3A1Q1 is the same as the input of the gate A3A1U2.

3-22. TIME DELAY CIRCUIT. There is a time delay of approximately 60 seconds when the set is turned on before the beam, repeller and control supply voltages are turned on. This delay is necessary in order that the klystron tube not be damaged. The time delay is accomplished by utilizing integrated circuit A4U1. Pin 3 of A4U1 is held high (approximately 12 volts) for a period determined by the RC time constant of A4R13 and A4C7. When A4C7 charges to a high enough level, the timer A4U1 changes its state at pin 3 from 12 volts to ground, which in turn, changes the output of voltage regulator A4U3 so that the oscillations start and all the supplies (-1250, -1750/-1850, and 40 V) turn on (see paragraph 3-32 for more details). Zener diode A4CR4 and resistor A4R14 are used to supply a bias voltage of 12 volts to integrated circuit A4U1.

3-23. SQUARE WAVE GENERATOR. Square waves, variable from 950-1050 Hz, are generated using A3A1U3 and A3A1U4. A3A1U4 is utilized as an oscillator whose frequency is determined by A3A1C17, A3A1R34, A3A1R36, and A3A1R37. The oscillator frequency is adjusted by varying A3A1R36. The oscillator output (pin 3) is fed to the D-type flip-flop A3A1U3 (pin 11). The output frequency of A3A1U3 is 1/2 that of the output of A3A1U4 as characterized by the flip-flop. The output of A3A1U3 (pin 13) is applied to the Schmitt trigger A3A1U2 through the MODULATION SELECTOR switch only in the INT SQ WAVE position. The bias supplies for A3A1U3 and A3A1U4 are tapped from the 40V supply in the same manner as for A3A1U2 (see paragraph 3-21). The bias supply is turned off when the INT SQ WAVE mode of operation is not used.

3-24. MODULATION SELECTION. The six-position MODULATION SELECTOR switch A3A1S1 selects the proper mode of operation for the various functions. The klystron grid is biased so that it is held positive (approximately 10V) with respect to the cathode in CW,INT FM~, and EXT FM positions and is held to cut-off(approximately -30 volts with respect to the cathode) in the RF OFF and EXT ⊓⊔ ⊔ positions. In the INT SQ WAVE position it is switched between +10 and -30 volts. The grid voltage is determined by the adjustment of A5A2R5 which in turn sets the beam current (see paragraph 3-34c). The circuit operation in each position of the MODULATION SELECTOR switch is described in paragraphs 3-25 through 3-30.

3-25. RF OFF POSITION. In the RF OFF position, the voltage at the input to the Schmitt trigger gate is returned to ground through the MODULATION SELECTOR switch. The output of the amplifier A3A1Q1 is,therefore,at ground potential (-1280 ref gnd) and the grid is thus placed at a negative potential sufficient to drive the klystron into cut-off and thus inhibiting oscillation.

3-26. CW POSITION. In the CW position, the voltage at the input to the Schmitt trigger gate(pin 1 of A3A1U2) is

held at +12V (with respect to −1280V as referenced ground). The output of the amplifier is thus +40V and the grid is thus placed at a potential that permits the klystron to oscillate.

3-27. INT SQ WAVE POSITION. In the INT SQ WAVE position the intput to the Schmitt trigger is fed from the output of flip-flop A3A1U3.The square wave output of the flip-flop moves the Schmitt trigger gate up and down at the same rate. The grid driven by the amplifier, therefore, modulates the klystron oscillations, producing a square wave modulation of output. The rate itself, is controlled by the setting of A3A2R36 which changes the frequency of the basic oscillator A3A1U4.

3-28. EXT ⊓ ⊔ POSITION. In the EXT ⊓ ⊔ position, the input to the Schmitt trigger gate is placed at ground potential (−1280V) so that initially the klystron tube does not conduct. The input to the Schmitt trigger, however, is driven by positive going pulses from an external source applied at the EXT MOD connector J3. The klystron tube conducts only during that portion of the cycle when the pulse is on.

3-29. INT FM~ POSITION. In the INT FM~ position the Schmitt trigger is biased so that the output of the amplifier is at +40V; thus, the grid is at a potential so that oscillations in the klystron tube take place. The voltage on the repeller electrode of the tube is modulated by a sine wave voltage as derived from the line voltage through transformer A2T1. The FM deviation is determined by resistor A3A3R16 and the rate is fixed at the line frequency. In addition, a horizontal sweep output is available at connector J1 whose phase can be varied by HOR SWP PHASE control resistor A3A3R4. With the use of the HOR SWP OUT and PHASE controls, the rf output modulation can be viewed on an oscilloscope with the aid of an RF detector.

3-30. EXT FM POSITION. In the EXT FM position, the oscillations take place as described in the INT FM~ position. The repeller voltage is modulated by the external voltage applied at connector J2.

3-31. ΔF CONTROL. The ΔF control varies the repeller voltage over a relatively small range to provide a frequency vernier adjustment.

3-32. BEAM (−1250V), REPELLER (−1750/−1850V), AND THE +40V (−1280V)REF GROUND POWER SUPPLIES. The power supplies used for generation of beam, repeller and control circuits are not conventional. A block diagram of the processes by which high voltages are generated is shown in Figure 3-2. A low voltage power supply (approximately 31V) is derived from the line voltage using a conventional, step-down transformer A2T1, bridge rectifier, and filter networks for low ripple. It supplies the main current for subsequent conversion to a high voltage ac generator. The dc voltage is converted to a low voltage, high frequency, ac power source (20 KHz, typical) by oscillator A5Q1 and A5Q2. The low ac voltage is stepped up to suitable ac voltages by transformer A5T2.

3-32A. LOW VOLTAGE DC POWER SUPPLY. The main ac line voltage is stepped down to approximately 31 vac and rectified using bridge rectifier A4BR1. The rectified voltage is filtered and the ripple is kept low using Darlington capacitor multiplier A4Q4 and A4Q5. Capacitor A4C1 provides the fundamental filtering. The effective capacitance of A4C2 is increased by the current gains of A4Q4 and A4Q5.

3-32B. LOW VOLTAGE HIGH FREQUENCY AC VOLTAGE GENERATOR. The dc voltage as generated in paragraph 3-32A is subsequently converted into low ac voltage at a high frequency as follows. Two PNP transistors A5Q1 and A5Q2, and transformer A5T1 comprise the basic oscillator. The emitter is connected to the +31V dc line through the current limiter A4Q1. The bias voltage to the bases is determined by the collector voltage of transistor A4Q3. The collector voltage of A4Q3 is set initially (before A5Q1 and A5Q2 oscillate or the time delay is over) by BIAS ADJ resistor A4R4. Resistor A4R4 is in the base-emitter circuit of A4Q2; hence, it sets the voltage for the collector of A4Q2 or emitter of A4Q3. Initially the emitter of A4Q3 is set as approximately 11V so that A5Q1 and A5Q2 do not oscillate. (The emitter to base voltage of A4Q3 is thus <0.7 volts.) The base voltage of A4Q3 is determined by the output of voltage regulator A4U3 which is a monolithic integrated circuit. The voltage between the NON-INVERTING (pin 3) and INVERTING (pin 2) inputs of A4U3 is amplified internally by A4U3 and appears at pin 6,which in turn is connected to the base of A4Q3 through load resistor A4R9. Pin 10 of A4U3 is biased with resistors A4R16 and A4R17 such that the regulator does not regulate initially. The junction of A4R16 and A4R17 is approximately 0.8V initially. When the delay time is over, this junction voltage changes to zero volts and the regulator starts to regulate. The output at pin 6, which is determined by the voltage difference between pins 2 and 3, is such that A4Q3 conducts and in turn A5Q1 and A5Q2 start to oscillate. The amplitude of the oscillations is adjusted by A4R21. (When A4R21 is adjusted, the base voltage of A4Q3 varies and this in turn varies the base current of A5Q1 and A5Q2 and

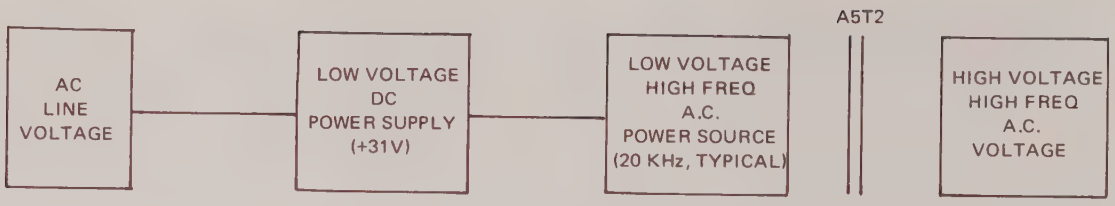


Figure 3-2. High Voltage Generation, Block Diagram

hence the amplitude of the oscillations). Voltage reference for pin 2 is derived from the fixed voltage regulator A4U2. Constant voltage is maintained at pin 6 and hence that of the oscillations amplitude by A4U3 which senses any variation of the difference in voltages between pins 2 and 3. Pin 2 is fixed by the resistor network A4R19, A4R21, and A4R22 and at pin 3 voltage is derived by feedback network A4R18 and A5A1R7. If there is any variation at pin 3 due to load or line voltages,the regulator will correct all changes through its feed back loop and maintain a constant amplitude of oscillation. A4CR1 is added for the protection of A4Q2 and diodes A5CR1 to A5CR4 are added for the protection of A5Q1 and A5Q2.

3-32C. HIGH VOLTAGE – HIGH FREQUENCY AC VOLTAGE. The output of the basic oscillator (low voltage, high frequency is stepped up through transformer A5T2 to suitable values.

3-32D. BEAM POWER SUPPLY. High voltage fast switching rectifier diodes A5A1CR9. to A5A1CR12 rectify the high voltage ac appearing across pins 8 and 10 of transformer A5T2. After suitable filtering, it is applied to the klystron cathode (–1250V).

3-32E. THE REPELLER VOLTAGE. AC voltage appearing across pins 4 and 6 of the transformer (Models 1107E and 1207E) or 4 and 7 (Models 1108E and 1208E) is rectified by diodes A5A2CR5 to A5A2CR8 and applied to the voltage regulator network A3A1CR8, A3A1CR9 to A3A1CR12, A3A1Q2 and A3A1Q3. A3A1CR8, A3A1CR9 to A3A1CR12 are zener diodes which establish a reference voltage for the regulator A3A1Q2 and A3A1Q3 are used in a Darlington arrangement to provide the necessary regulation. The ground repeller supply is referenced to the –1250V beam supply.

3-32F. THE +40V SUPPLY FOR CONTROL CIRCUITS. The bridge rectifier A5BR1 rectifies the ac voltage across pins 11 and 12 of transformer A5T2. This +40V is applied to the op-amp A5A2U1 whose output floats at –1250V. The output of the op-amp is connected to the inverting input (pin 2) of the op-amp and the non-inverting input is floating and can be varied from 0 to 32 volts (32 volts appearing across zener diode A5A2CR15) by resistor A5A2R5 and thus the entire +40V supply floats at –1250V

3-33. KLYSTRON FILAMENT SUPPLY. The klystron filament is supplied with regulated dc voltage to minimize drift and incidental amplitude and frequency modulation. The klystron filament supply consists of bridge rectifier A3A1BR1 and voltage regulator A3A1U1. It is referenced to the –1250V beam supply. The filament voltage is adjusted to 6.3V by potentiometer A3A1R1.

3-34. POWER SUPPLY ADJUSTMENTS. The power supplies are provided with three adjustments which are described below:

a. –1250 ADJ CONTROL. The –1250 ADJ control A4R21 sets the operating point for control amplifier A4U3 which maintains the beam power supply at its set value.

b. –1750/–1850 ADJ CONTROL. The –1750/–1850 ADJ control A3A1R2 sets the operating point for regulator A3A1Q2 and A3A1Q3 which maintains the repeller power supply at its set value.

c. BEAM CURRENT ADJ control. The BEAM CURRENT ADJ control A5A2R5, which has a range of approximately 32 volts, adjusts the beam current through the klystron. The beam current is measured by monitoring the voltage across A5A1R8 which appears between A4TP2 and A4TP4.

SECTION IV

MAINTENANCE

4-1. GENERAL.

4-2. This section contains maintenance and alignment procedures for the Modular Microwave Signal Generators and Sources, Models 1107E, 1108E, 1207E, and 1208E. Included in this section are a list of test equipment required, minimum performance standards for the instruments, a troubleshooting procedure, and the alignment procedures required for the instruments.

4-3. TEST EQUIPMENT REQUIRED.

4-4. Table 4-1 lists the test equipment required for the maintenance of Models 1107E, 1108E, 1207E, and 1208E. Test equipment of equivalent characteristics may be substituted for the items listed.

4-5. PRELIMINARY INSPECTION.

4-6. Perform a preliminary visual and manual inspection of the instrument before undertaking any maintenance procedure. Remove the top and bottom dust covers of the instrument to inspect its interior. Look for loose or damaged parts, dust, dirt, oil or grease, and corrosion. Correct such conditions before proceeding with maintenance.

WARNING

THE STABILIZER INPUT TERMINAL BOARD, ON THE REAR PANEL, HAS A REGULATED POTENTIAL OF 1750/1850 VOLTS DC ON ITS TERMINALS. SEVERE SHOCK OR DEATH MAY RESULT FROM ACCIDENTAL CONTACT WITH THESE TERMINALS. THE TERMINALS ARE COVERED TO PREVENT ACCIDENTAL CONTACT. THE COVER SHOULD NOT BE REMOVED UNLESS AN EXTERNAL LOCK BOX IS TO BE CONNECTED.

CAUTION

DO NOT DISTURB ANY ADJUSTMENTS ON COMPONENTS OF THE KLYSTRON OSCILLATOR CASTING. A COMPLETE REALIGNMENT MAY BE REQUIRED IF ANY ADJUSTMENTS ARE TOUCHED.

4-7. MINIMUM PERFORMANCE STANDARDS.

4-8. The minimum performance standards listed in table 4-2 will determine whether the instrument is operating within the specification limits listed in table 1-2.

4-9. TROUBLESHOOTING.

4-10. The troubleshooting procedure for the instrument is given in table 4-3. If the location of the trouble is indefinite or cannot be localized, start the troubleshooting procedure at the step that most closely resembles the trouble encountered.

WARNING

A REGULATED DC VOLTAGE OF 1750/1850 VOLTS WILL BE ENCOUNTERED DURING THE TROUBLESHOOTING TESTS. DO NOT CONNECT OR DISCONNECT TEST EQUIPMENT WHICH CONNECTS INTERNALLY WITH THE INSTRUMENT ENERGIZED.

4-11. DISASSEMBLY AND REASSEMBLY INSTRUCTIONS.

4-12. Disassembly and reassembly instructions for the instrument are given in paragraphs 4-13 through 4-17. Component locations are shown in figures 4-8 through 4-13.

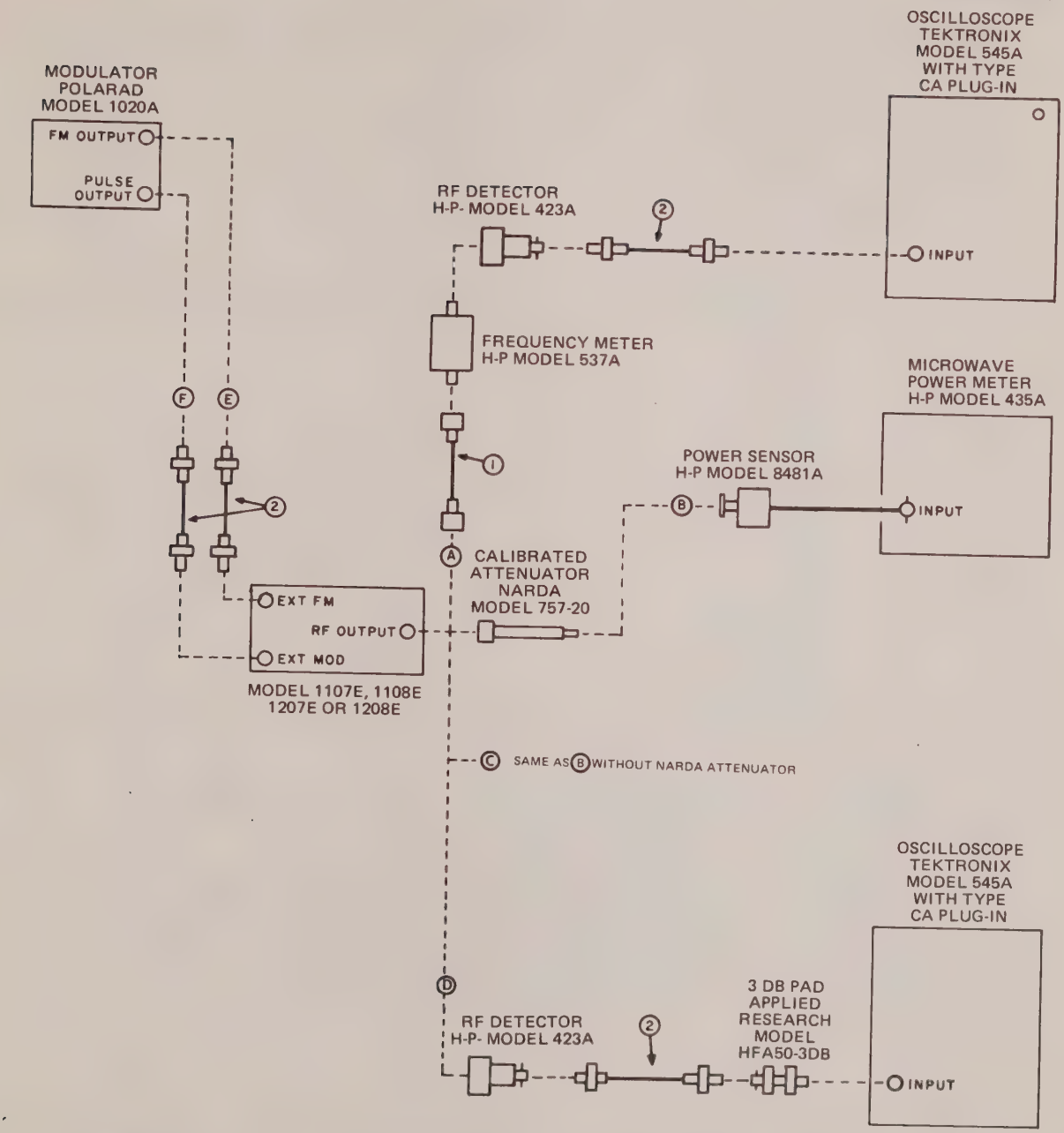
Note

1. Do not disassemble the instrument beyond the point at which the necessary repair or replacement can be made. Perform the applicable minimum performance checks of table 4-2 after any replacement procedure given below.

2. If it is necessary to remove the RF ATTENUATOR probe or the POWER SET probe, replace the RF ATTENUATOR probe first and then the POWER SET probe for proper alignment (Models 1107E and 1108E only).

TABLE 4-1. TEST EQUIPMENT REQUIRED

Name	Manufacturer and Model No.	Use
DIFFERENTIAL VOLTMETER	Fluke Model 801	Voltage tests
FREQUENCY METER	Hewlett-Packard Model 537A	Frequency tests
MODULATOR	Polarad Model 1020A	External modulation tests
MULTIMETER, DIGITAL	Fluke Model 8000A	Voltage, current, and resistance tests
OSCILLOSCOPE	Tektronix Model 545A with Type CA plug-in	Frequency, square wave, and pulse tests
PAD, 3 db	Applied Research Model HFA50-3DB	Square wave and pulse tests
PAD, 20 db	Narda Model 757-20	Power output tests
POWER METER WITH SENSOR	Hewlett-Packard Model 435A and 8481A	Power output and attenuator tests
RF DETECTOR	Hewlett-Packard Model 423A	Klystron mode alignment, square wave and pulse tests
VOLTBOX	Fluke Model 605B	Voltage tests



(1) RF CABLE P/N B12551 SUPPLIED WITH MODELS 1107E, 1108E, 1207E, 1208E.

(2) VIDEO CABLE

(A) FREQUENCY ACCURACY

(B) POWER OUTPUT TESTS

(C) ATTENUATOR ACCURACY TESTS

(D) INTERNAL SQUARE WAVE AND FM TESTS

(E) EXTERNAL FM TESTS

(F) EXTERNAL PULSE TESTS

Figure 4-1. Minimum Performance Standards Test Setups

TABLE 4-2. MINIMUM PERFORMANCE STANDARDS

Step	Purpose	Procedure	Normal Indication	Abnormal Indication Ref.
1	Evaluate power operating conditions	Connect instrument under test to power source and set POWER switch to ON.	POWER indicator lights when power is applied. Delay circuit operates after approximately 60 seconds.	Check DS1, A1F1, A1S1, power cable, and setting of 115/230 volt switch A1S2. Check A4U1 and associated components.
2	Evaluate POWER SET operation (1107E and 1108E)	Adjust the instrument under test for CW operation at low end of frequency range. Refer to paragraph 2-10.Tune thru the frequency band,resetting the POWER SET control for CAL. 1107E: 3.7 to 8.4 GHz 1108E: 6.95 to 11.0 GHz	Power monitor meter deflects to CAL.	See table 4-3, steps 6A and 13.
3A	Evaluate maximum power output (1107E and 1108E)	Connect test equipment as shown in figure 4-1, test setup B. At the frequencies listed below, check for maximum uncalibrated power output. Set POWER SET control fully counterclockwise. 1107E: 4.00, 6.00, 8.10 1108E: 7.00, 9.00, 11.00	The uncalibrated power outputs for the Models 1107E and 1108E are as follows: 1107E: 4.0 GHz, ⩾ 10 mw 6.0 GHz, ⩾ 10 mw 8.1 GHz, ⩾ 5 mw 1108E: 7.0 GHz, ⩾ 10 mw 9.0 GHz, ⩾ 10 mw 11.0 GHz, ⩾ 10 mw	Refer to paragraph 4-14

TABLE 4-2. MINIMUM PERFORMANCE STANDARDS (Cont'd.)

Step	Purpose	Procedure	Normal Indication	Abnormal Indication Ref.
3B	Evaluate maximum power output (1207E and and 1208E)	Repeat step 3A and check for maximum power output at the frequencies listed below. 1207E: 4.00, 6.00, 8.00 1208E: 6.95, 9.00, 11.00	The uncalibrated power outputs for the Models 1207E and 1208E are as follows: 1207E: 4.0 GHz, ⩾ 60 mw 6.0 GHz, ⩾ 55 mw 8.0 GHz, ⩾ 25 mw 1208E: 6.95 GHz, ⩾ 75 mw 9.0 GHz, ⩾ 30 mw 11.0 GHz, ⩾ 30 mw	Refer to paragraph 4-14
4	Evaluate attenuator accuracy (1107E and 1108E)	Connect test equipment as shown in figure 4-1, test setup C. At the frequencies listed below, check attentuator accuracy at +3.0, −5, −10, −15, and −20 dbm. 1107E: 4.00, 6.00, 8.00 1108E: 6.95, 9.00, 11.00	±2 db absolute accuracy	Refer to paragraph 4-14
5	Evaluate frequency readout accuracy	Connect test equipment as shown in figure 4-1, test setup A. Adjust frequency meter, for dip, to determine signal frequency at the following FREQUENCY GHz readout settings: 1107E/1207E: 3.70, 4.50 1108E/1208E: 7.00, 7.50	Frequency meter reading is within ±0.5% of FREQUENCY GHz readout. 1107E/1207E Limits: 3.682 to 3.718, 4.478 to 4.522 1108E/1208E Limits: 6.965 to 7.035, 7.463 to 7.537	Refer to paragraph 4-25

TABLE 4-2. MINIMUM PERFORMANCE STANDARDS (Cont'd.)

Step	Purpose	Procedure	Normal Indication	Abnormal Indication Ref.
5 Cont.		1107E/1207E: 5.50, 6.50, 7.50, 8.40 1108E/1208E: 8.00, 8.50, 9.00, 9.50, 10.00, 10.50, 11.00 **Note** All frequency checks should be made at an output power level of one milliwatt. Set ΔF control to zero.	1107E/1207E Limits: 5.473 to 5.527; 6.468 to 6.532; 7.463 to 7.537; 8.358 to 8.442 1108E/1208E Limits: 7.960 to 8.040; 8.458 to 8.542; 8.955 to 9.045; 9.453 to 9.547; 9.950 to 10.050; 10.448 to 10.552; 10.945 to 11.055	
6	Evaluate internal square wave operation	Connect test equipment as shown in figure 4-1, test setup D. Set MODULATION SELECTOR switch to INT SQ. WAVE and vary INT SQ. WAVE control. Check square wave frequency with oscilloscope.	Square wave frequency varies typically from 950 to 1050 Hz, minimum	See table 4-3, step 7A or 7B.
7	Evaluate internal FM operation	a. Connect test equipment as shown in figure 4-1, test setup D.		See table 4-3, step 8.

TABLE 4-2. MINIMUM PERFORMANCE STANDARDS (Cont'd.)

Step	Purpose	Procedure	Normal Indication	Abnormal Indication Ref.
7 Cont.		b. Connect the HOR SWP OUT to the EXT SWEEP IN of the oscilloscope. c. Set oscilloscope HORIZONTAL for EXT SWEEP mode. d. Set the EXT SWEEP ATTEN so that it fills the entire horizontal sweep. e. Set the MODULATION SELECTOR switch to INT FM ~ f. Vary the INT FM DEV control.	The entire mode should be swept and the pattern should look like fig.4-5C, when properyly phased using the HOR SWP PHASE control. **Note** The sweep may not be symmetrical about the center frequency.	
8	Evaluate external FM operation	Connect test equipment as shown in figure 4-1, test setup D & E.Set MODULATION SELECTOR switch to EXT FM and vary FM AMPLITUDE control on Model 1020A Modulator. Check sweep width with frequency meter.	Sweep width varies with variation in FM AMPLITUDE control.	See table 4-3, step 9.
9	Evaluate external pulse operation	Connect test equipment as shown in figure 4-1, test setups D and F. Set MODULATION SELECTOR switch to EXT ⎍⎍ . Set PULSE WIDTH and RATE controls on 1020A Modulator to desired values. Observe pulses on oscilloscope.	Steady pulses with set pulse width and rate should be observed. **Note** Using Model 1020A as the external pulse source, the modulation duty cycle will be exceeded if a pulse rate higher than approximately 350 Hz is used at the maximum delay of 2000 μsec.	See table 4-3, step 10.

TABLE 4-3. TROUBLESHOOTING PROCEDURE

Step	Purpose	Procedure	Normal Indication	If Indication Is Abnormal
1	Check beam current	a. Set digital multimeter for 20v range. Connect pin 4 of the test connector A4TP1 (provided as an accessory) to V-Ω of the multimeter and pin 2 to the COMMON. b. Set MODULATION SELECTOR switch to CW. c. Allow instruments to warm up for 20 minutes. d. Scan through the frequency range.	Multimeter will indicate 2.1 to 2.6. Proceed to step 2.	Refer to paragraph 4-22. Check klystron tube V1 and associated circuitry. Check voltage and resistance values listed in Table 5-1.
2	Check beam power supply voltage	a. Set differential voltmeter and voltbox for 5000 dc volt range. b. Connect voltmeter + lead to chassis and − lead to pin 2 of connector A3A1J8.	Differential voltmeter will indicate a beam power supply voltage of −1250 volts ±1%. Proceed to step 3.	Refer to paragraph 4-20.
3	Check repeller power supply voltage	a. Disconnect voltmeter − lead from pin 2 of connector A3A1J8 and connect it to pin 3 of A3A1J5. b. Turn ΔF control fully clockwise. **Note** Return ΔF control to "0" position after test.	Voltmeter will indicate a repeller power supply voltage of 1750/1850 volts ±1%. Proceed to step 4.	Refer to paragraph 4-21.

TABLE 4-3. TROUBLESHOOTING PROCEDURE (Cont'd.)

Step	Purpose	Procedure	Normal Indication	If Indication Is Abnormal
4	Check 40-volt power supply	a. Set digital voltmeter for 200 volt dc range. b. Connect V-Ω lead of digital multimeter to pin 3 of A3A1J8 and common lead to pin 4 of A3A1J8.	Voltmeter will indicate 40 volts ±10%. Proceed to step 5.	Check A5BR1 and associated circuitry
5	Check klystron filament supply voltage	a. Disconnect multimeter. b. Set multimeter for 20-volt dc range. c. Connect multimeter COMMON lead to pin 3 of connector A3A1J3 and V-Ω lead to pin 2 of A3A1J3.	Voltmeter will indicate approximately 6.3 volts. Proceed to step 6.	Check A3A1BR1 and A3A1U1 and associated circuitry.
6A	Check cw operation. (Models 1107E and 1108E only)	a. Disconnect multimeter. b. Set FREQUENCY GHz dial to low end of range. c. Adjust POWER SET control for a power monitor indication of CAL. d. Adjust FREQUENCY GHZ dial upward in 200 MHz increments and repeat step c at each increment.	Power monitor indication of CAL can be obtained over entire frequency range. Proceed to step 7A.	Check V1, A3A1S1, A3A1U2, A3A1Q1 and associated circuitry. Check Level Detector Z1,A8M1 and associated circuitry.
6B	Check cw operation. (Models 1207E and 1208E only)	a. Disconnect multimeter. b. Connect test equipment as shown in figure 4-1, test setup B.	Power meter indications for Models 1207E and 1208E should be as follows over their respective frequency ranges.	Check V1, A3A1S1, A3A1U2, A3A1Q1 and associated circuitry.

TABLE 4-3. TROUBLESHOOTING PROCEDURE (Cont'd.)

Step	Purpose	Procedure	Normal Indication	If Indication Is Abnormal
6B Cont.		c. Set FREQUENCY GHz dial to low end of range. d. Adjust the ATTENUATOR control on the Model 1207E and 1208E for the following indications when checking the frequency range of the instruments: 1207E: 3.7 to 4.3 GHz, ⩾60 mw 4.3 to 5.0 GHz, ⩾25 mw 5.0 to 6.6 GHz, ⩾55 mw 6.6 to 8.4 GHz, ⩾ 25 mw 1208E: 6.95 to 8.00 GHz, ⩾75 mw 8.00 to 11.0 GHz, ⩾30 mw	1207E: 3.7 to 4.3 GHz, ⩾ 60 mw 4.3 to 5.0 GHz, ⩾ 25 mw 5.0 to 6.6 GHz, ⩾ 55 mw 6.6 to 8.4 GHz, ⩾ 25 mw 1208E: 6.95 to 8.00 GHz, ⩾ 75 mw 8.00 to 11.0 GHz, ⩾ 30 mw Proceed to step 7B.	
7A	Check internal square wave operation (Models 1107E 1108E only)	a. Connect test equipment as shown in figure 4-1, test setup D. b. Set FREQUENCY GHz dial to mid-range. c. Adjust POWER SET control for a power monitor indication of CAL. d. Set MODULATION SELECTOR switch to INT SQ. WAVE. e. Vary INT SQ. WAVE control over its range.	Power monitor indication will change approximately −3 or less when MODULATION SELECTOR switch is set to INT SQ WAVE. Square wave varies typically from 950 to 1050 Hz	Check A3A1U3, A3A1U4 and associated circuitry.

TABLE 4-3. TROUBLESHOOTING PROCEDURE (Cont'd)

Step	Purpose	Procedure	Normal Indication	If Indication Is Abnormal
7B	Check Internal square wave operation. (Models 1207E and 1208E)	a. Connect test equipment as shown in figure 4-1,test setup D. b. Set FREQUENCY GHz dial to mid-range. c. Adjust ATTENUATOR control on Models 1207E/1208E for an indication of 1 milliwatt. d. Set MODULATION SELECTOR switch to INT SQ WAVE. e. Vary INT SQ WAVE control over its range.	Square waves with a frequency range of 950 to 1050 Hz, should be observed.	Check A3A1U3, A3A1U4 and associated circuitry.
8	Check internal fm operation	a. Connect test equipment as shown in figure 4-1,test setup D. b. Connect the HOR SWP OUT to the EXT SWEEP IN of the oscilloscope. c. Set oscilloscope HORIZONTAL DISPLAY to EXT SWEEP mode. d. Set the EXT SWEEP ATTEN so that it fills the entire horizontal sweep. e. Set the MODULATION SELECTOR switch to INT FM~. f. Vary the INT FM DEV control.	The entire mode should be swept and the pattern should be like figure 4-5C, when properly phased using the HOR PHASE control.	Check 2T1, A3A3R16, A3A1S1 and associated circuitry.

TABLE 4-3. TROUBLESHOOTING PROCEDURE (Cont'd.)

Step	Purpose	Procedure	Normal Indication	If Indication Is Abnormal
9	Check external fm operation.	a. Connect test equipment as shown in figure 4-1, test setups D and E. b. Set MODULATION SELECTOR to EXT FM. c. Set 1020A Modulator pulse rate to 1000 Hz approximately. d. Vary FM DEV AMPLITUDE control on Modulator 1020A.	Sweep width varies with variation in FM DEV AMPLITUDE control.	Check A3A1S1 and associated circuits.
10	Check external pulse operation.	a. Connect test equipment as shown in figure 4-1, test setups D and F. b. Set MODULATION SELECTOR switch to EXT ⊓⊔ ⎍ c. Set PULSE WIDTH and RATE controls on Model 1020A Modulator to any desired value. Observe pulses on oscilloscope.	Steady pulses with set pulse width and rate should be observed. **Note** Using Model 1020A as the external pulse source, the modulation duty cycle will be exceeded if a pulse rate higher than approximately 350 Hz is used at the maximum delay of 2000 μsec.	Check A3A1S1,A3A1Q1, A3A1U2 and associated circuitry.
11	Check attenutator operation.	a. Connect test equipment as shown in figure 4-1, test setup B. b. Set MODULATION SELECTOR to CW. c. Vary ATTENUATOR control.	Power meter indication will vary in unison with rotation of ATTENUATOR control.	Refer to paragraph 4-14.

TABLE 4-3. TROUBLESHOOTING PROCEDURE (Cont'd.)

Step	Purpose	Procedure	Normal Indication	If Indication Is Abnormal
12A	Check RF OFF function (Models 1107E,1108E)	Set MODULATION SELECTOR to RF OFF.	Power monitor and power meter indicate zero	Adjust mechanical zero adjustment of A8M1. Check A3S1 circuits.
12B	Check RF OFF function (Models 1207E,1208E)	Same as step 12A, test setup B	Power meter indicates zero.	Check A3A1S1 circuits.
13	Check power monitor operation (Models 1107E, 1108E only)	a. Set MODULATION SELECTOR switch to CW. b. Vary POWER SET control.	Power monitor indication varies from −3 to +3 smoothly.	Check meter A8M1 and associated circuitry.

4-13. REMOVAL OF ATTENUATOR PROBE ASSEMBLY. To remove the attenuator probe assembly (see figure 4-8), proceed as follows:

a. Rotate knob to withdraw probe from pipe.

b. Unfasten and remove the cable clamp that secures the attenuator probe cable to the casting.

c. Loosen setscrews in attenuator probe collar.

d. Carefully pull the probe out of the collar.

e. Remove the screws that secure RF OUTPUT connector J5.

f. Feed the connector J5 back out of the panel.

g. Unthread the attenuator probe assembly through the casting hole.

4-14. REPLACEMENT OF ATTENUATOR PROBE ASSEMBLY. To replace the attenuator probe assembly, proceed as follows:

CAUTION

ADVANCING THE ATTENUATOR TOO DEEPLY (MODEL 1108E ONLY) INTO THE KLYSTRON CAVITY WILL DAMAGE THE CAVITY.

a. With the grounded side of the probe to the front for Model 1207E and to the rear for Models 1107E/1108E/1208E, thread the attenuator probe assembly cable W15 through the casting hole provided, with connector J5 positioned near its mounting holes and the probe tip adjacent to the probe collar. Insert the probe tip through the probe collar and into the attenuator barrel. Rotate the ATTENUATOR control fully clockwise. Push the attenuator in gently until it stops. Back off slightly and tighten the setscrews.

b. Mount and fasten connector J5.

c. Replace cable clamp.

d. Rotate the attenuator control to withdraw the probe. Switch the POWER switch to ON. Select CW mode of operation.

e. Connect power meter to instrument (figure 4-1, test setup B) and proceed according to the applicable step below.

(1) Models 1107E and 1108E. Operate attenuator probe to obtain a power meter indication of 0 dbm. Adjust POWER SET control to bring indicator to 0 on -DBM scale. Adjust A3A1R31 to set POWER MONITOR meter to CAL. (See paragraphs 4-15 and 4-16 for POWER SET removal and replacement.)

(2) Models 1207E and 1208E. Operate instrument to determine frequency at which minimum power output is obtained and rotate the ATTENUATOR control fully counterclockwise, i.e., collar closest to barrel. Adjust probe insertion until power meter reading just starts to drop after reaching a peak, then tighten setscrew in probe collar.

f. Disconnect power meter.

4-15. REMOVAL OF POWER SET PROBE ASSEMBLY (MODELS 1107E, 1108E ONLY). To remove the power set probe assembly (see figure 4-10) proceed as follows:

a. Rotate the POWER SET control fully counterclockwise. Also rotate ATTENUATOR control fully clockwise.

b. Unfasten and remove the cable clamp that secures the power set probe cable W9.

c. Disconnect connector W9P7 from the level detector Z1.

d. Loosen the setscrew that secures the power set probe in the probe block.

e. Carefully slide the probe out of the power set pipe on the klystron cavity.

f. Remove the power set probe assembly from the instrument.

4-16. REPLACEMENT OF POWER SET PROBE ASSEMBLY (MODELS 1107E, 1108E ONLY). To replace the power set probe assembly, proceed as follows:

a. Rotate ATTENUATOR control fully clockwise and rotate the POWER SET control fully clockwise.

b. Place instrument on its left side to bring probes uppermost and accessible.

c. With the grounded side of the probe tip towards the rear, insert the probe end through the probe block into the power set pipe on the klystron cavity. Push the probe in until it just touches the the mode supressor and back off slightly. Tighten the setscrew (as in paragraph 4-15d).Slip the connector end of the power set probe assembly through the space between the attenuator probe and the side frame. Rotate both probe controls counterclockwise.

CAUTION

ADVANCING THE POWER SET PROBE TOO DEEPLY (MODEL 1108E ONLY) INTO THE KLYSTRON CAVITY WILL DAMAGE THE CAVITY.

d. Connect probe connector A7P1 to the microwave power meter (figure 4-1, test setup C) and adjust the power meter for 3 mw range. Switch the POWER switch to ON and operate in CW mode of operation (see paragraph 2-10).

e. Tune the instrument over its range and determine the frequency at which the minimum power output occurs.

f. With the instrument tuned to the frequency at which minimum output power is obtained, adjust the RF ATTENUATOR control for an output power of 0 dBm (use setup C,figure 4-1). Set hairline of POWER SET control in line with 0 on attenuator dial.

g. Loosen the setscrews that secure the POWER SET in the probe block and adjust the amount of probe insertion in the barrel for a power meter indication of 1.5 mw.

CAUTION

GROUND MUST BE TO THE REAR

h. Tighten the setscrew that secures the power set probe in the probe block.

i. Disconnect the power meter.

j. Depress power set cable W9 toward level detector Z1.

k. Install and fasten the cable clamp around W9.

l. Connect connector W9P7 to level detector Z1.

4-17. REPLACEMENT OF KLYSTRON OSCILLATOR TUBE V1. To replace klystron oscillator tube V1 (figure 4-2 or 4-2A), proceed as follows:

WARNING

BEFORE REPLACING KLYSTRON, DISCONNECT POWER CORD.

a. Adjust frequency to low end of range.

b. Loosen klystron cover holding clamp and remove cover carefully. Disconnect klystron socket from tube.

c. Place the instrument resting on its front handles and hold or secure in this position.

d. Loosen the knurled nut with a spanner wrench (Polarad P/N AP15550).

e. Remove the knurled nut.

f. Extract the old klystron from the cavity by screwing the klystron clockwise and pulling it out of the cavity at the same time.

g. Remove the spacer, washer and springs. Remove the springs from the cores, and replace with the new ones supplied with the replacement klystron. Note that the new springs are stiff. Stretch the springs slightly until they are no longer stiff, but droop slightly. When stretching the springs, use care since they stretch easily, and overstretching **cannot** be corrected.

h. Cut approximately 1/8 inch from each end with sharp cutters. Push the spring around the core. If the spring has been cut properly, the opening across the two ends of the spring will be 1/16 inch or less. If the opening is larger, stretch the spring a little more. If the opening is less, cut a little off one end.

i. Repeat the above for the other spring and core.

j. Insert one spring and core into the cavity with the open end to the right.

k. Insert the thin washer.

l. Insert the other spring and core into the cavity with the open end to the left.

m. Insert the large spacer and screw on the knurled nut all the way by hand; then back off the nut one-half of a turn so that it is loose.

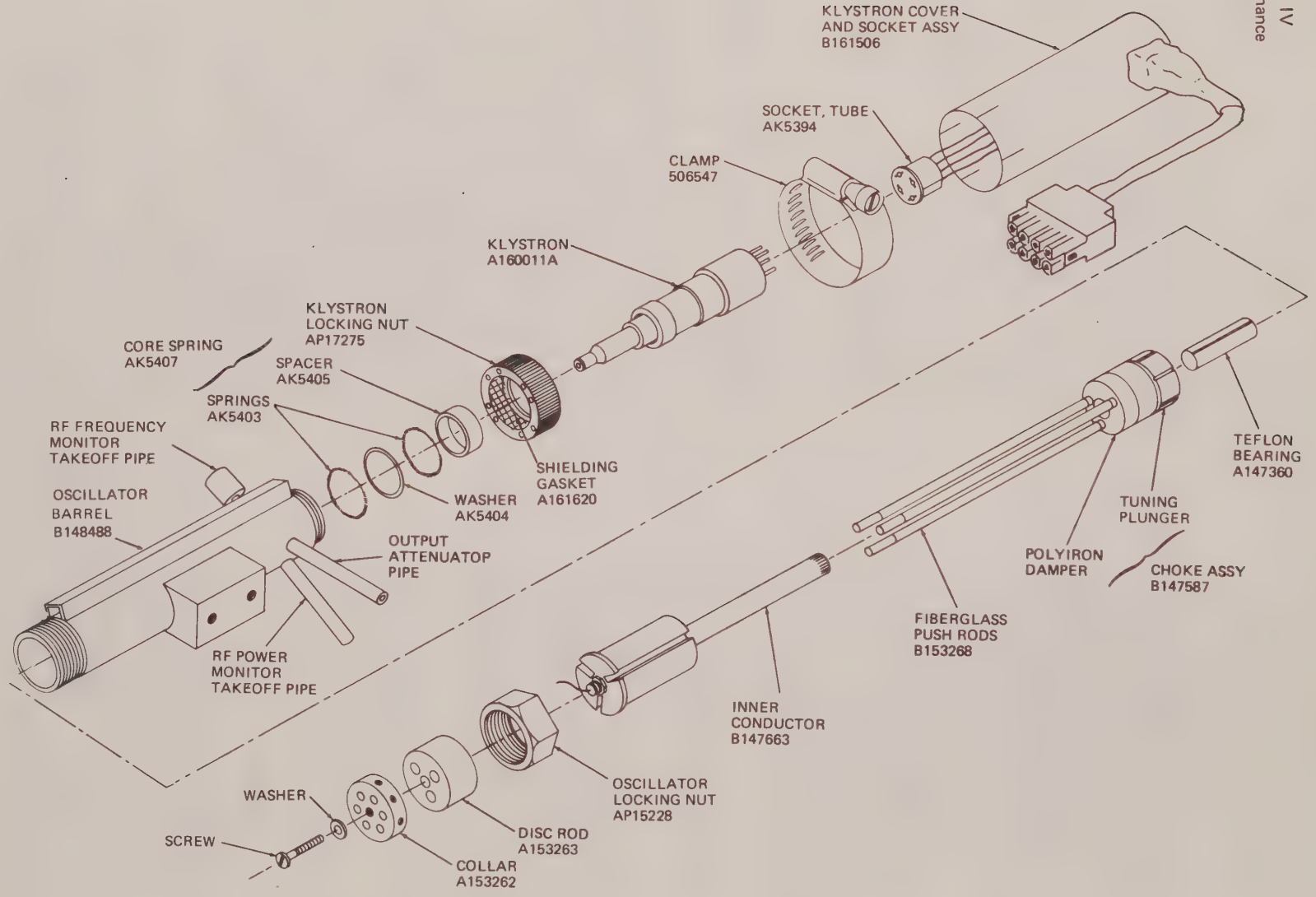


Figure 4-2. Klystron Cavity, Exploded View (Models 1107E and 1207E)

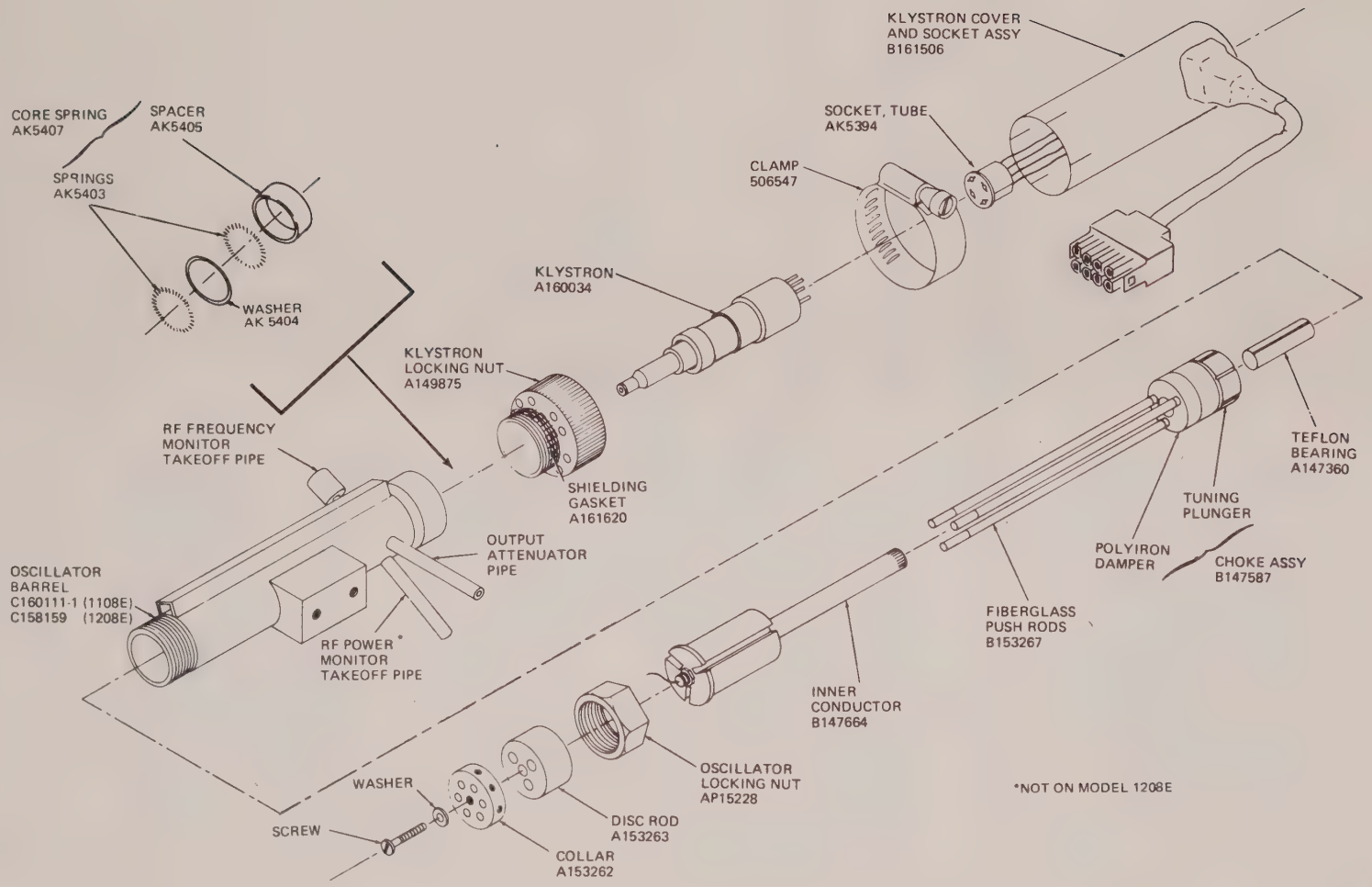


Figure 4-2A. Klystron Cavity, Exploded View (Models 1108E and 1208E)

n. Insert the new klystron into the cavity by pushing straight in until it stops.

o. Rotate the klystron slightly **clockwise**, and push simultaneously until the tube suddenly moves forward and a distinct click is heard. If the tube does not move forward or a grinding sound is heard, the springs have not been stretched enough. This should be corrected by repeating steps e through o.

p. Back off knurled nut 1/4 turn in a counterclockwise direction.

Note

It should also be noted that when pushing the tube, a fair amount of force is required. If the klystron is pushed straight in and NOT on an angle, this force will not harm it.

q. The tube is now passed over the first spring. Continue rotating the tube slightly **clockwise** and pushing the tube until the tube moves in again and another click is heard. Now rotate the tube 1/4 turn clockwise, and hand-tighten the knurled nut. After making electrical tests, tighten knurled nut with spanner wrench an additional 1/4 turn.

r. Attach extension cable (Polarad No. A160465) between the klystron and the cover socket. (An extension cable may be fabricated using Amphenol Socket 78-S4S and Plug 71-4S.) Use vinyl electrical tape around soldered pins. These points are at dangerous voltages.

s. Align the unit in accordance with the procedures outlined in paragraph 4-18 through 4-27.

4-18. ADJUSTMENT AND CALIBRATION PROCEDURES. (See paragraph 4-30 for use of the Test Connector as an aid in making test measurements.)

4-19. Instrument adjustment and calibration procedures are given in paragraph 4-20 through 4-27. After performing any of the adjustment and calibration procedures given below, perform the minimum performance checks given in table 4-2. Connect power cord to ac source and switch POWER switch to the on position.

WARNING
HIGH VOLTAGES ARE PRESENT AND PROPER SAFETY PRECAUTIONS MUST BE EXERCISED WHEN MAKING ANY ADJUSTMENTS

4-20. −1250 VOLT ADJUSTMENT. To adjust the −1250 volt supply, set the instrument for CW operation and proceed as follows:

a. Rotate BEAM CURRENT ADJ A5A2R5 to midpoint.

b. Set digital multimeter to 20 VDC range. Connect pin 4 of the test connector A4TP to V-Ω of the multimeter and pin 2 to COMMON.

c. Adjust BEAM CURRENT ADJ A5A2R5 for an indication of 2.50V on the multimeter (see figure 4-13 for location of A5A2R5).

d. Set differential voltmeter for 6000-volt dc range, connect + lead to chassis, and − lead to pin 2 of connector A3A1J8.

e. Adjust the H.V. ADJ control A4R21 for 1250 volts (see figure 4-12 for location of A4R21).

f. Glyptol-lock the potentiometer A4R21.

g. Disconnect the differential voltmeter.

4-21. −1750/−1850 VOLT ADJUSTMENT. To adjust the −1750/−1850 volt supply, set the instrument for CW and proceed as follows:

a. Set differential voltmeter for 6000-volt dc range, connect + lead to chassis, and the − lead to pin 3 of connector A3A1J5 and turn ΔF control fully clockwise.

b. Adjust the −1750/−1850 control A3A1R42 for 1750/1850 volts (see figure 4-11 for location of A3A1R42).

c. Glyptol-lock potentiometer A3A1R42.

d. Disconnect the differential voltmeter.

e. Return the ΔF control to the center "0."

4-22. BEAM CURRENT ADJUSTMENT. To adjust the beam current after adjusting the −1250 and −1750/−1850 volt supplies, set the instrument for CW operation and proceed as follows:

a. Set digital multimeter to the 20 VDC range. Connect pin 4 of the test connector A4TP to V-Ω of the multimeter and pin 2 to COMMON.

b. Adjust BEAM CURRENT ADJ control A5A2R5 for 2.50 V on the multimeter.

c. Scan through the frequency band and readjust so that 2.50 V is minimum at any point.

d. Glypto-lock BEAM CURRENT ADJ potentiometer A5A2R5.

e. Disconnect the multimeter with the tube oscillating.

4-23. FILAMENT VOLTAGE ADJUSTMENT. To adjust the filament voltage proceed as follows:

a. Connect the digital voltmeter to pin 2 of connector A3A1J3 and the COMMON lead to pin 3 of connector A3A1J3.

b. Adjust 6.3 ADJ control A3A1R1 for +6.3 volts (see figure 4-11 for location of A3A1R1).

4-24. INT FM DEV RANGE ADJUSTMENT. To adjust the range of INT FM DEV control, set instrument for CW mode of operation and proceed as follows:

a. Set MODULATION SELECTOR switch to INT FM~.

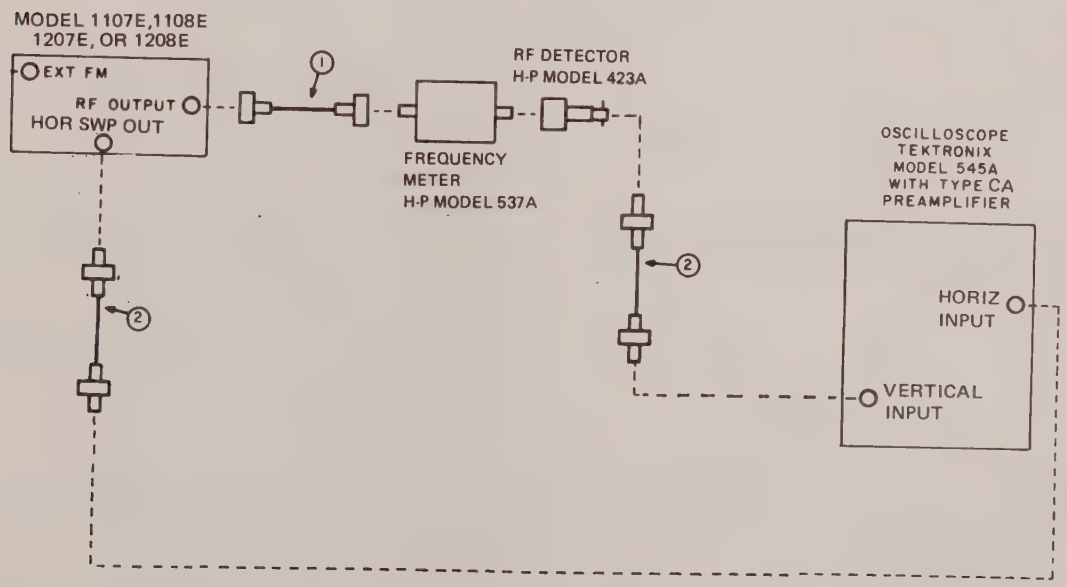
b. Connect equipment as shown in figure 4-3.

c. Adjust the INT FM DEV control fully counterclockwise.

d. Adjust HOR SWP PHASE control so that mode pattern of figure 4-5C is obtained.

e. Adjust INT FM DEV range adjustment A3A1R17 so that complete mode patterns can be observed of the respective model (see figure 4-11 for location of A3A1R17).

4-25. KLYSTRON FREQUENCY ALIGNMENT. Due to variations in klystron repeller voltage characteristics and other parameters, the tuning cam and repeller voltage



(1) RF CABLE P/N B12551 SUPPLIED WITH MODELS 1107E, 1108E, 1207E, 1208E
(2) VIDEO CABLE P/N B12553 (OPTIONAL)

Figure 4-3. Test Setup for Klystron Frequency and Repeller Tracking Adjustments

adjustments must be made whenever the klystron is replaced or the performance of the instrument doesn't meet the minimum performance requirements of table 4-2. To align the klystron for frequency and repeller voltage tracking, proceed as follows:

Note

The voltage and current adjustments of paragraphs 4-20 through 4-24 must be performed before klystron alignment is begun.

a. Connect test equipment as shown in figure 4-3.

Note

If a component in the repeller voltage tracking circuitry has been replaced, or the glyptol locks of the tracking potentiometers have been broken, set all tracking potentiometers to their typical repeller voltage as indicated in figure 4-6 or 4-7. If only the klystron has been replaced, this preliminary rough setting is not required.

b. Set MODULATION SELECTOR switch to INT FM~.

c. Apply power to instrument and test equipment and allow them to warm up for 15 minutes.

d. Rotate frequency control knob to position the cam follower at the fixed point on the tuning cam shown in figure 4-4.

Note

Set ΔF control at "0."

e. Check the FREQUENCY GHz readout. It should be about 5.8 GHz for Models 1107E and 1207E or 8.85 GHz for Models 1108E and 1208E.

f. Adjust attenuator output level, INT FM DEV and HOR SWP PHASE controls and oscilloscope to obtain a stable display of the klystron mode pattern, similar to figure 4-5, pattern C.

g. Tune frequency meter to place dip due to frequency meter at peak of mode pattern as shown in figure 4-5, pattern D.

h. Frequency meter reading should be within ±0.1% of FREQUENCY GHz readout. If it is not, loosen the socket head screw in the cam follower yoke (figure 4-8) and adjust push rod yoke to bring frequency within tolerance. Retune frequency meter to check push rod yoke adjustment and then tighten socket head screw.

i. The klystron tube must now be rotated for maximum output. The extension cable should be inserted as described in paragraph 4-17r. and the knurled nut loosened.

j. Slowly tune the frequency to the top of the frequency range (8.4 GHz or 11.0 GHz) while observing the mode pattern.

k. If the mode pattern disappears before the high end is reached, the rotation will start at that point. Be sure that the attenuator is not too far in to collapse the mode pattern. If the mode pattern is present to the highest frequency, the rotation of the klystron will proceed at 8.4 GHz or 11.0 GHz.

CAUTION

WEAR A HIGH INSULATION GLOVE DURING THE KLYSTRON ROTATION TO PROTECT AGAINST HEAT AND ELECTRICAL SHOCK

l. Rotate the klystron slowly clockwise while observing the mode pattern display. Stop rotating when the center mode pattern is at its greatest amplitude. The total rotation should not be more than 270°.

m. Switch the POWER switch to its OFF position and tighten the klystron knurled nut. Remove the jumper cable, reconnect the klystron socket to the klystron base and replace the klystron cover.

n. Switch the POWER switch to on and after the proper time delay (60 seconds approximately).Repeat step e and then continue with step o and the other following steps.

o. Rotate the frequency control knob to position eccentric adjustment 4 (figure 4-4) opposite the cam follower. Tune frequency meter to check instrument frequency, which should be within ±0.1% of FREQUENCY GHz readout. If frequency is not within tolerance, loosen the four screws (three screws on Models 1108E and 1208E) on the top of the tuning cam for adjustments 4, 5, 6, and additionally 7 for Models 1107E and 1207E.

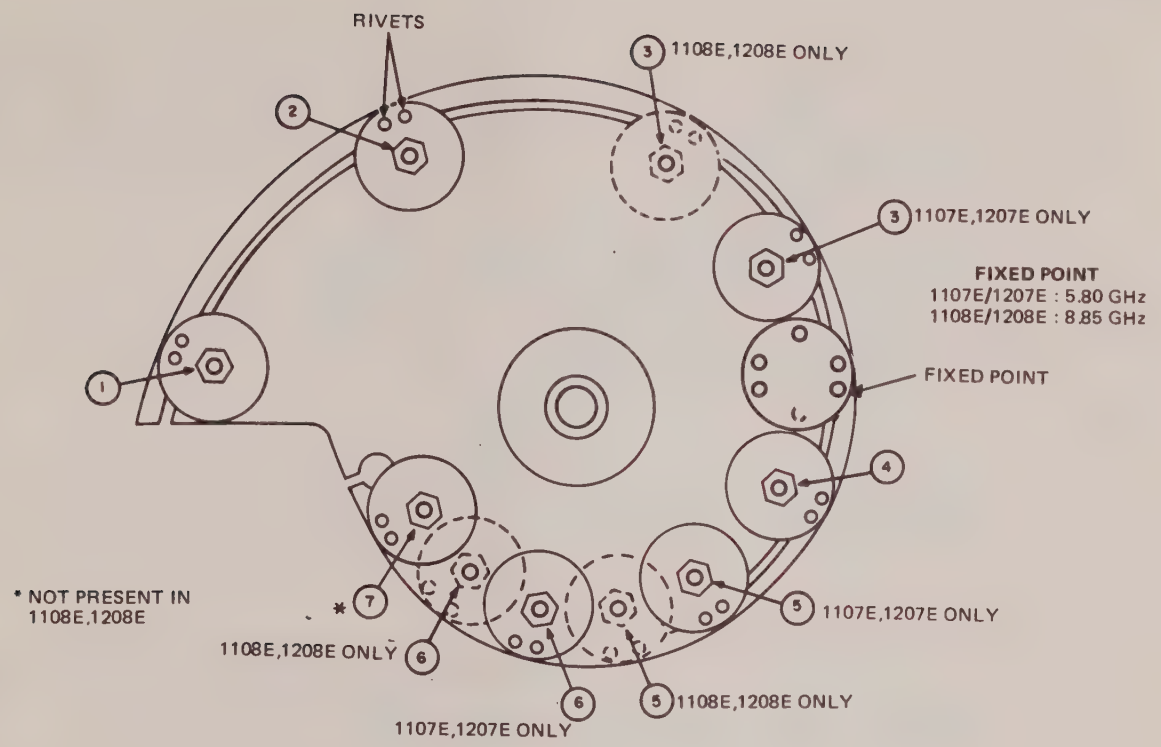
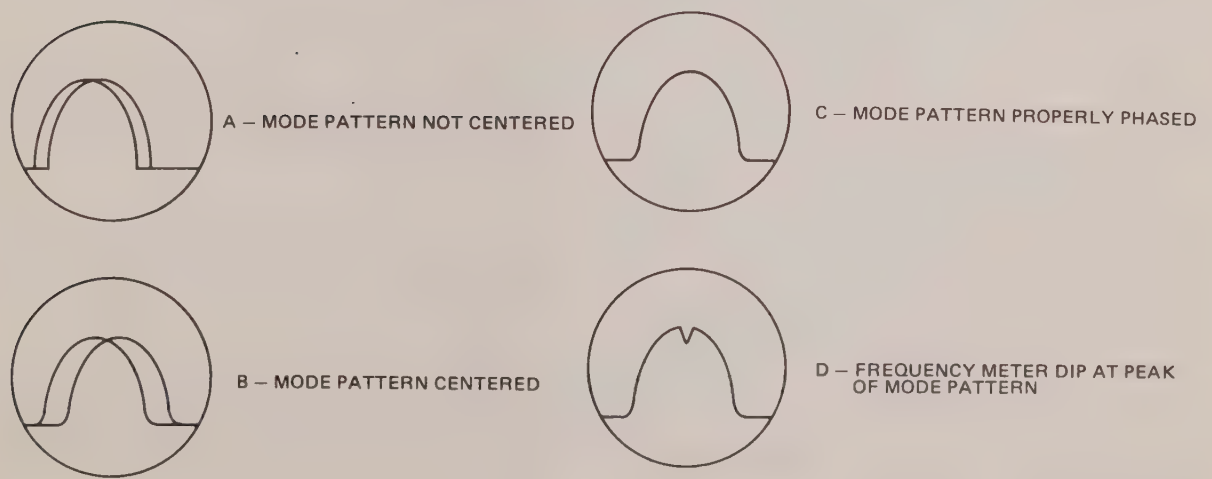


Figure 4-4. Tuning Cam Adjustments


A – MODE PATTERN NOT CENTERED
C – MODE PATTERN PROPERLY PHASED
B – MODE PATTERN CENTERED
D – FREQUENCY METER DIP AT PEAK
OF MODE PATTERN

Note: Patterns shown are for positive detected voltage RF Detector.
For negative detector, the patterns will be in the downward direction.

Figure 4-5. Mode Patterns

Note

If adjustment 4 requires change, loosen all four screws. If only one of the other adjustments require change, loosen that screw only and take care that the cam is not distorted.

p. To bring the instrument frequency within tolerance for adjustment 4, set frequency meter to the FREQUENCY GHz readout value for adjustment 4. Adjust hex nut 4 until the frequency is within tolerance. Recheck the frequency after tightening adjustment, and, if necessary, repeat adjustment after loosening screw on the top of the tuning cam.

q. Rotate frequency control knob to position eccentric adjustment 5 opposite the cam follower. Repeat procedure of steps o, p, and q for adjustment 5, 6, and 7 (Models 1107E and 1207E).

r. After making adjustment 7, recheck all frequencies for adjustments 6, 5, and 4.

s. Repeat step d. Frequency should be within ±0.5% of FREQUENCY GHz readout.

t. Rotate frequency control knob to position eccentric adjustment 3 opposite the cam follower. Instrument frequency should be within ±0.5% of the FREQUENY GHz readout. If frequency is not within tolerance, loosen the three screws on the top of the tuning cam for adjustments 3, 2, and 1.

u. To bring the instrument within tolerance, adjust hex nut 3 until frequency is within tolerance, then tighten screw on the top of the cam while holding adjustment 3 with a wrench. Tighten all top screws after adjustment.

v. Repeat steps t and u for adjustments 2 and 1.

w. After making adjustment 1, recheck all frequencies for adjustments 1, 2, and 3. If necessary, repeat steps t, u, and v.

x. Leave test setup operating for repeller tracking adjustments.

4-26. REPELLER VOLTAGE TRACKING ADJUSTMENTS. After completing the klystron frequency alignment of paragraph 4-25, proceed with the repeller voltage tracking adjustment given below. If the proper mode pattern is obtained prior to adjustment, omit the adjustment. The typical repeller voltage vs. frequency characteristics for Models 1107E and 1207E are shown in figure 4-6 and the typical repeller voltages vs. frequency characteristics for Models 1108E and 1208E are shown in figure 4-7.

a. Rotate the frequency control knob to the low end of the frequency range of the instrument.

Models 1107E and 1207E – 3.70 GHz
Models 1108E and 1208E – 6.95 GHz

b. Set MODULATION SELECTOR switch to INT FM~.

c. Adjust HOR SWP PHASE control to obtain a single trace, of the mode pattern, as in C of figure 4-5. If the mode pattern appears as A in figure 4-5, the repeller voltage is not correct for the klystron frequency. Adjust LOW potentiometer A6R1 to center the mode pattern, as in B of figure 4-5.

d. Rotate the frequency control knob to the point just before the mode switch A7S1 operates. If necessary adjust LOW MODE potentiometer A6R2 to center the mode pattern.

e. Models 1108E and 1208E. Rotate the frequency control knob to the point just after the mode switch A7S1 operates. If necessary, adjust HIGH MODE potentiometer A6R3 to center the mode pattern.

f. Models 1108E and 1207E. Rotate the frequency control knob to the high end of the frequency range of the instrument. Adjust HIGH potentiometer A6R4 to center the mode pattern.

g. Models 1107E and 1207E. Rotate the frequency control knob to the point just after the mode switch A7S1 operates. Adjust TRACK 1 potentiometer A6R3 to center the mode pattern.

h. Models 1107E and 1208E. Rotate the frequency control knob to the point just before the mode switch A7S2 operates. If necessary, adjust TRACK 2 potentiometer A6R4 to center the mode pattern.

i. Models 1107E and 1207E. Rotate the frequency control knob to the point just after the mode switch A7S2 operates. If necessary, adjust HIGH MODE potentiometer A6R5 to center the mode pattern.

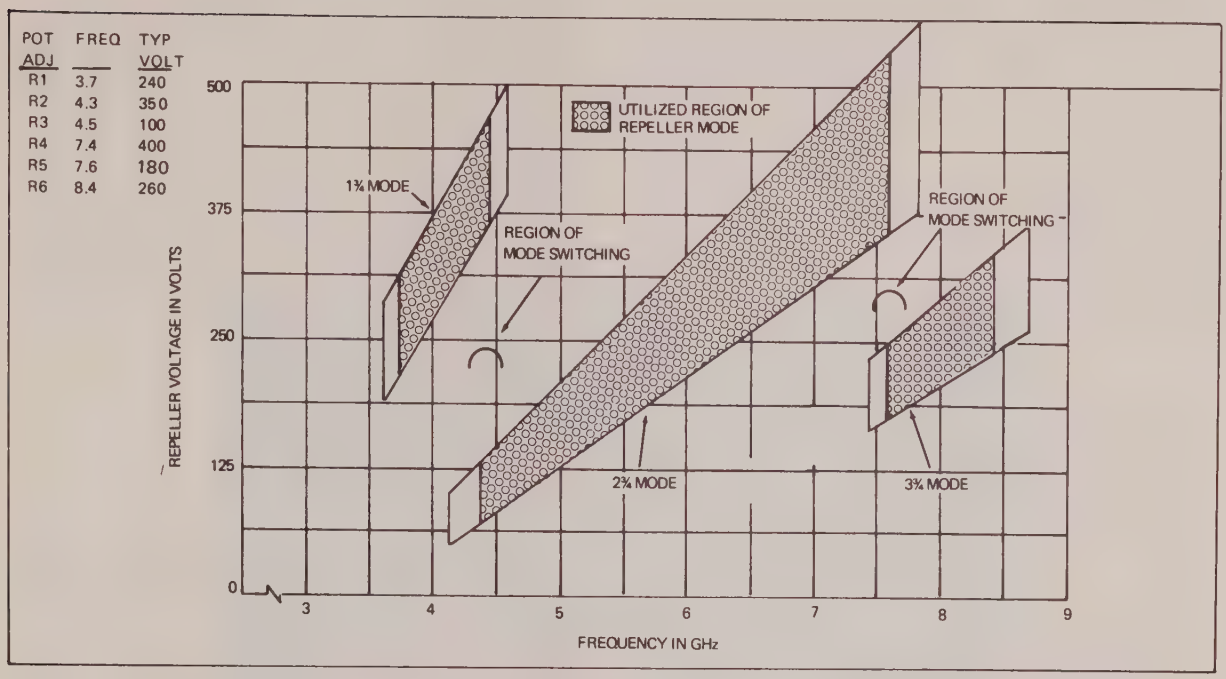


Figure 4-6. Typical Repeller Voltage Vs. Frequency Characteristics, Models 1107E and 1207E

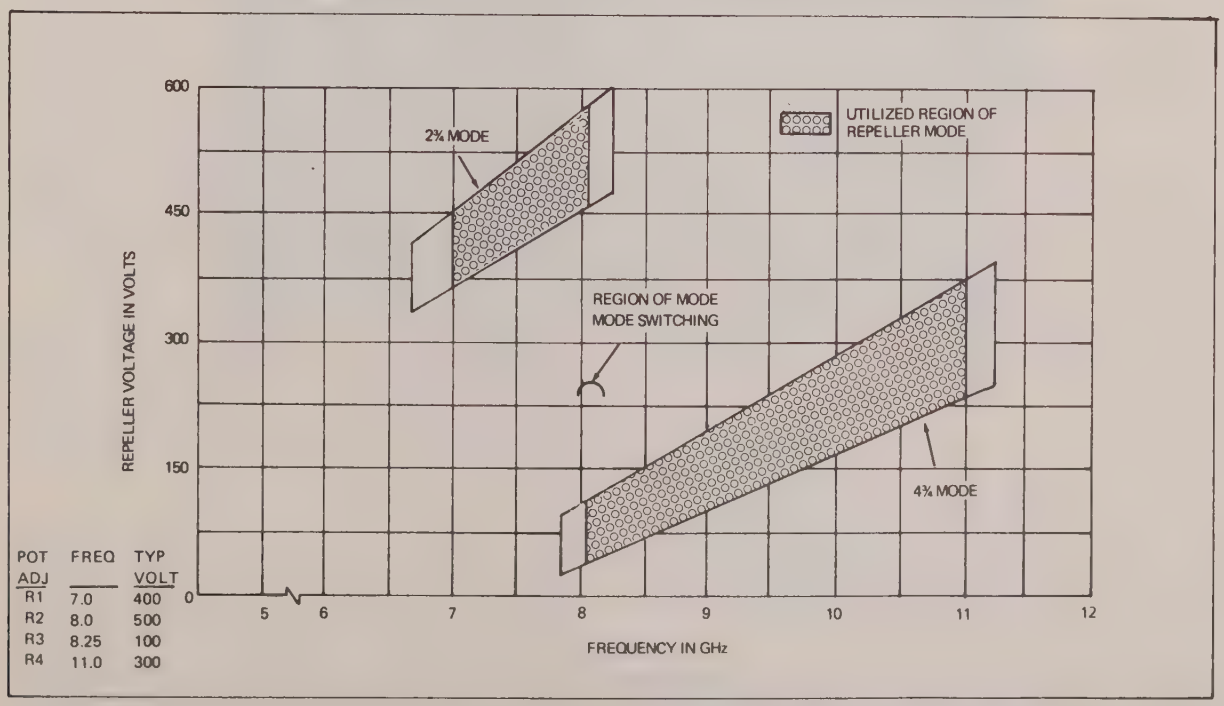


Figure 4-7. Typical Repeller Voltage Vs. Frequency Characteristics, Models 1108E and 1208E

j. Models 1107E and 1207E. Rotate the frequency control knob to the high end of the frequency range of the instrument. If necessary, adjust HIGH potentiometer A6R6 to center the mode pattern.

k. Rotate the frequency control knob to cover the complete frequency range of the instrument. The mode pattern, displayed on the oscilloscope, should be continuous, should remain centered, should not split into a double pattern, and should not exhibit a loss of power at any point in the frequency range. However, there should be an abrupt change in power level at the mode switching points.

l. It may be necessary to fine adjust the tracking potentiometers A6R1 through A6R4 for Models 1108E and 1208E and A6R1 through A6R6 for Models 1107E and 1207E for minimum pulse jitter. To adjust for minimum pulse jitter, use test setup F of figure 4-1. Adjust the external modulation source for 0.5μsec pulsewidth and scan through the frequency band. If at any frequency point (band), the pulse jitter exceeds 0.2 μsec, readjust the tracking potentiometer associated with that frequency. For example, if pulse jitter at 8.20 GHz is observed in Models 1108E/1208E, A6R3, the HIGH MODE potentiometer should be readjusted until the pulse jitter is minimum.

m. Glyptol-lock the shafts of all the tracking potentiometers.

(Models 1107E and 1207E – A6R1 through A6R6)
(Models 1108E and 1208E – A6R1 through A6R4)

4-27. MODELS 1107E and 1108E ONLY. If the power monitor meter A8M1 does not indicate CAL when the output level at the RF OUTPUT connector J5 is 0 dBm or 1 mw and the POWER SET dial is set, adjust METER CAL control A3A1R31 for a meter indication of CAL.

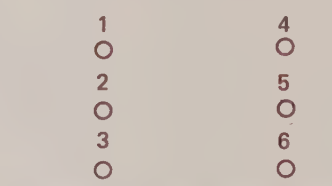
4-28. POWER OUTPUT CHECK. To check the power output of the instrument, perform steps 1, 3A or 3B, and 4 of table 4-2.

Note

If the probe is allowed to remain at a fixed position for all frequencies, it is possible that at some frequencies, the oscillator will stop oscillating. At these points, the probe should be retracted and reset for maximum output.

4-29. FINAL CHECK. To check the overal performance of the instrument, perform steps 3 and 6 through 9 of table 4-2. Replace the top, bottom, and right side dust covers.

4-30. ACCESSORY TEST CONNECTOR. The Test Connector, A713772, supplied as part of the accessory kit, is used to assemble a test cable to aid in evaluation of the performance of the signal generator and implement voltage adjustments. The cable may have a length of up to four feet without affecting performance. Under normal operating conditions, voltages should be below +40 volts. A failure, however, in the High Voltage Box A5 could bring this level up to several hundred volts. Caution should, therefore, be used when locating the end of the cable and when making measurements. Viewing from the top of the connector, the pin numbers will be as follows:



The following voltage table indicates normal operation, when the MODULATION SELECTOR switch is in the CW position and the voltage is at 115 vac.

	Pin Nos.	Indication	Tol
Klystron Beam Current	4(+) to 2	2.7 vdc	±10%**
Low Voltage DC Power Supply Voltage	1(+) to 2	31 vdc	±10%
Low Voltage DC Power Supply Current	5(+) to 1	450mvdc	±10%***
*Low Voltage Bias	6(+) to 2	12 vdc	±10%

*The bias voltage must be read during the first minute after turning on the set (klystron filament warmup interval before the high voltage is applied).
**This is equivalent to 27 ma going through A5A1R8.
***This is equivalent to 2.25 amp going through A4R1.

After checking the voltages listed in the above table, monitor the klystron beam current (pins 4 and 2). With the MODULATION SELECTOR switch in the CW position, the voltage should be between 2.5 and 2.9 volts. Push in RF OFF control and the voltages should drop to 0.4 volts. Push in IN SQ WAVE control and the voltage should increase to 1.4 to 1.6 volts.

Pin 3 controls the delay circuit, which allows the klystron filament to warm up before the application of the high voltage. During the first minute, the voltage at the pin will be approximately 800 millivolts. It will drop to 0 volts when the high voltage is activated. This is indicated when an RF signal is generated. The delay circuit may be overridden if pin 3 is shorted to ground. The RF signal will slowly build up as the filament is heated.

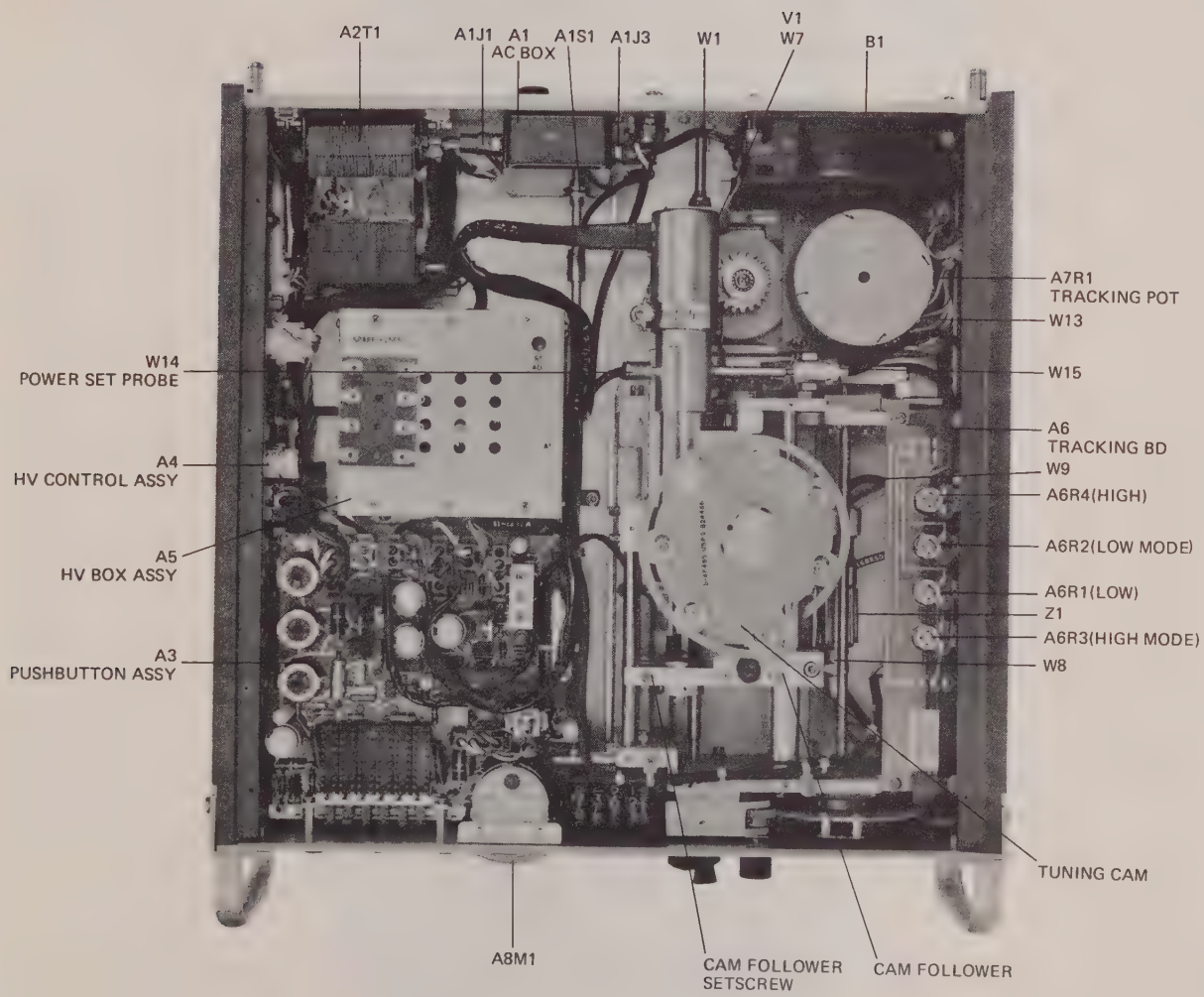


Figure 4-8. Typical Chassis, Top View

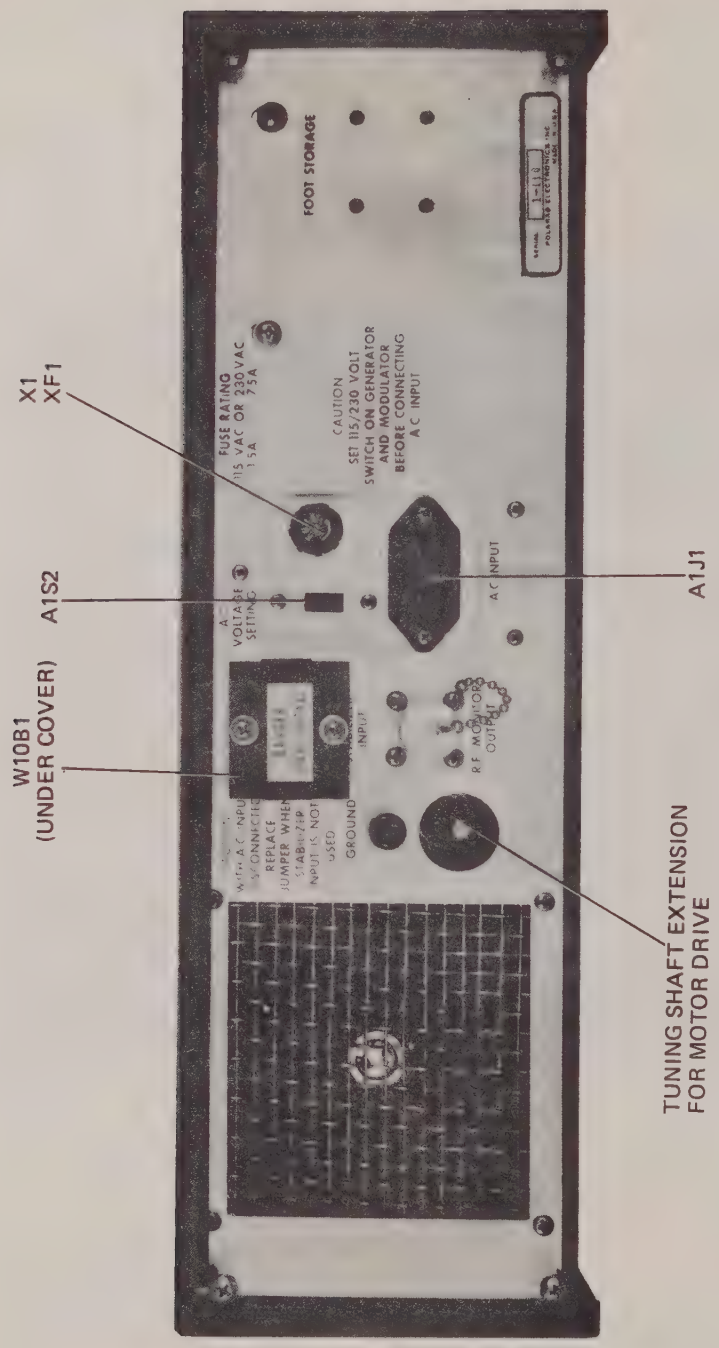


Figure 4-9. Models 1107E, 1108E, 1207E, and 1208E, Rear View

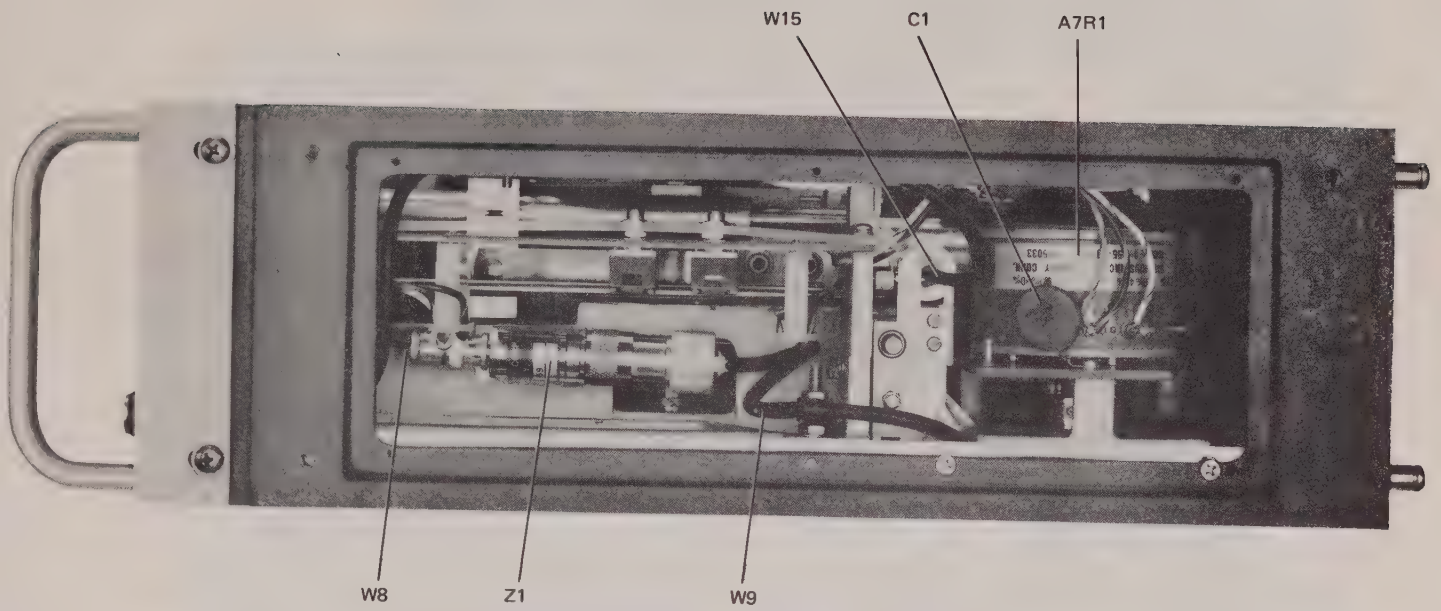


Figure 4-10. Models 1107E, 1108E, 1207E, and 1208E Chassis, Side View

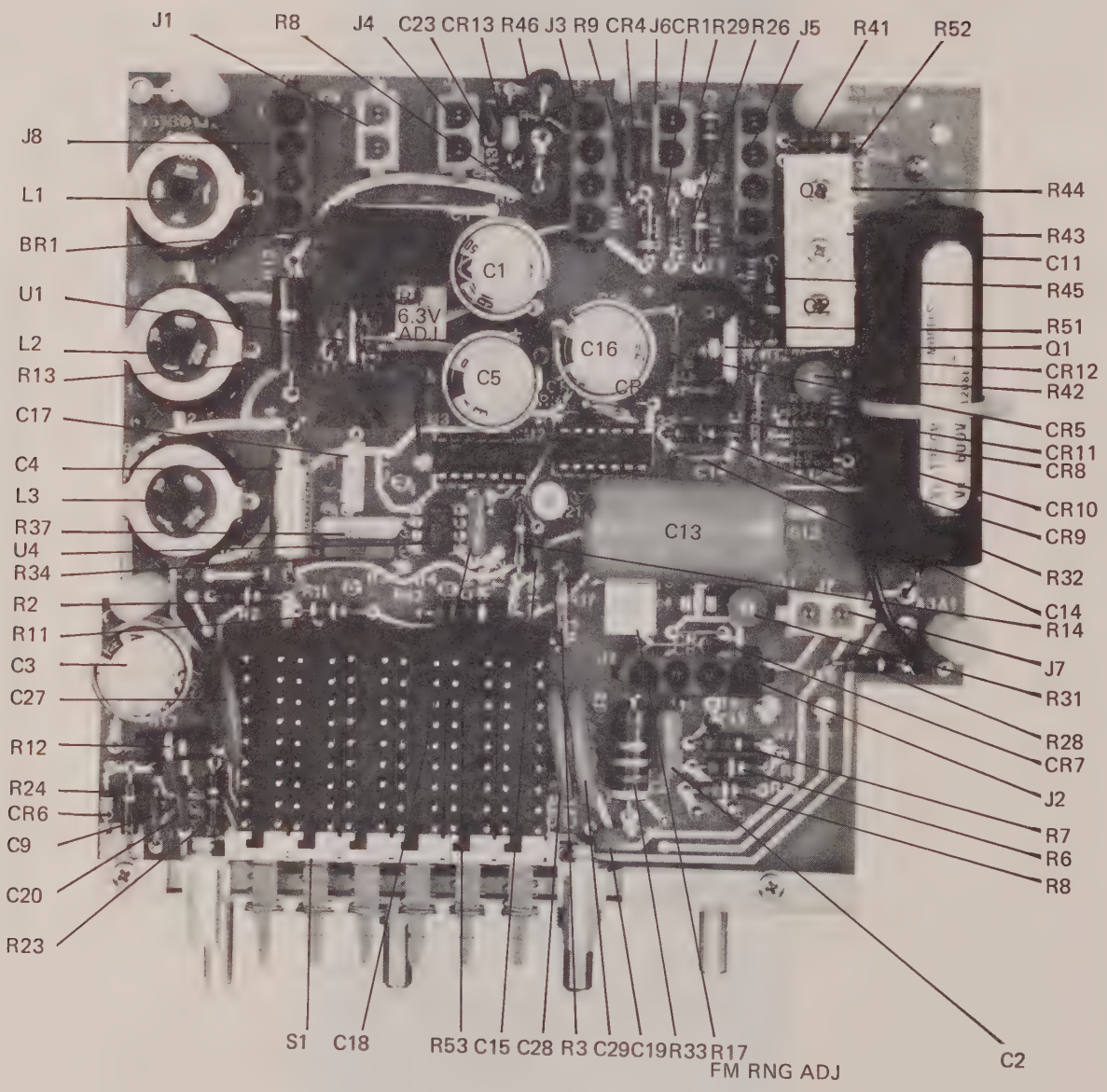


Figure 4-11. Pushbutton Board Assembly A3, Component Layout

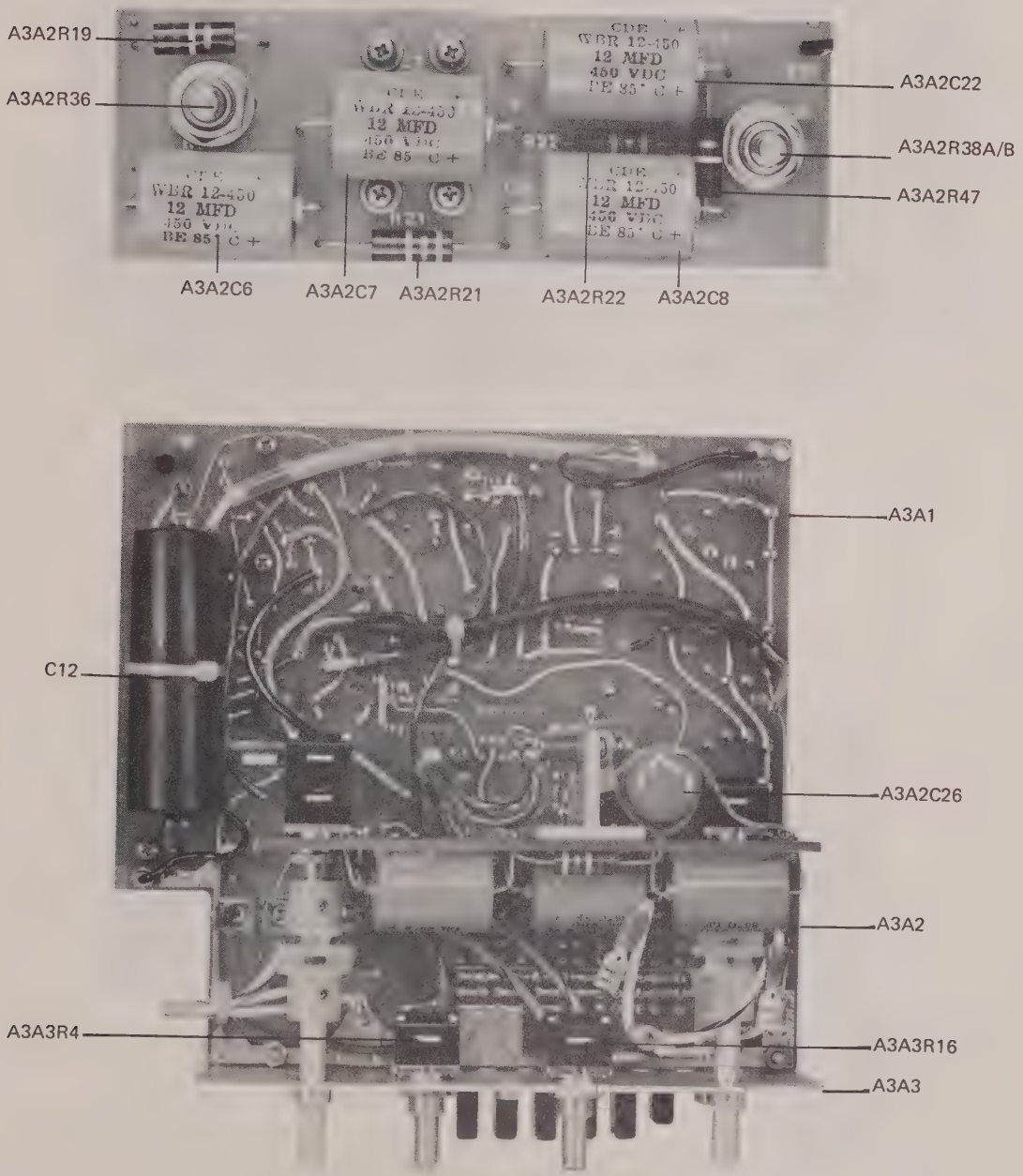


Figure 4-11. Pushbutton Board Assembly A3, Component Layout (Sheet 2)

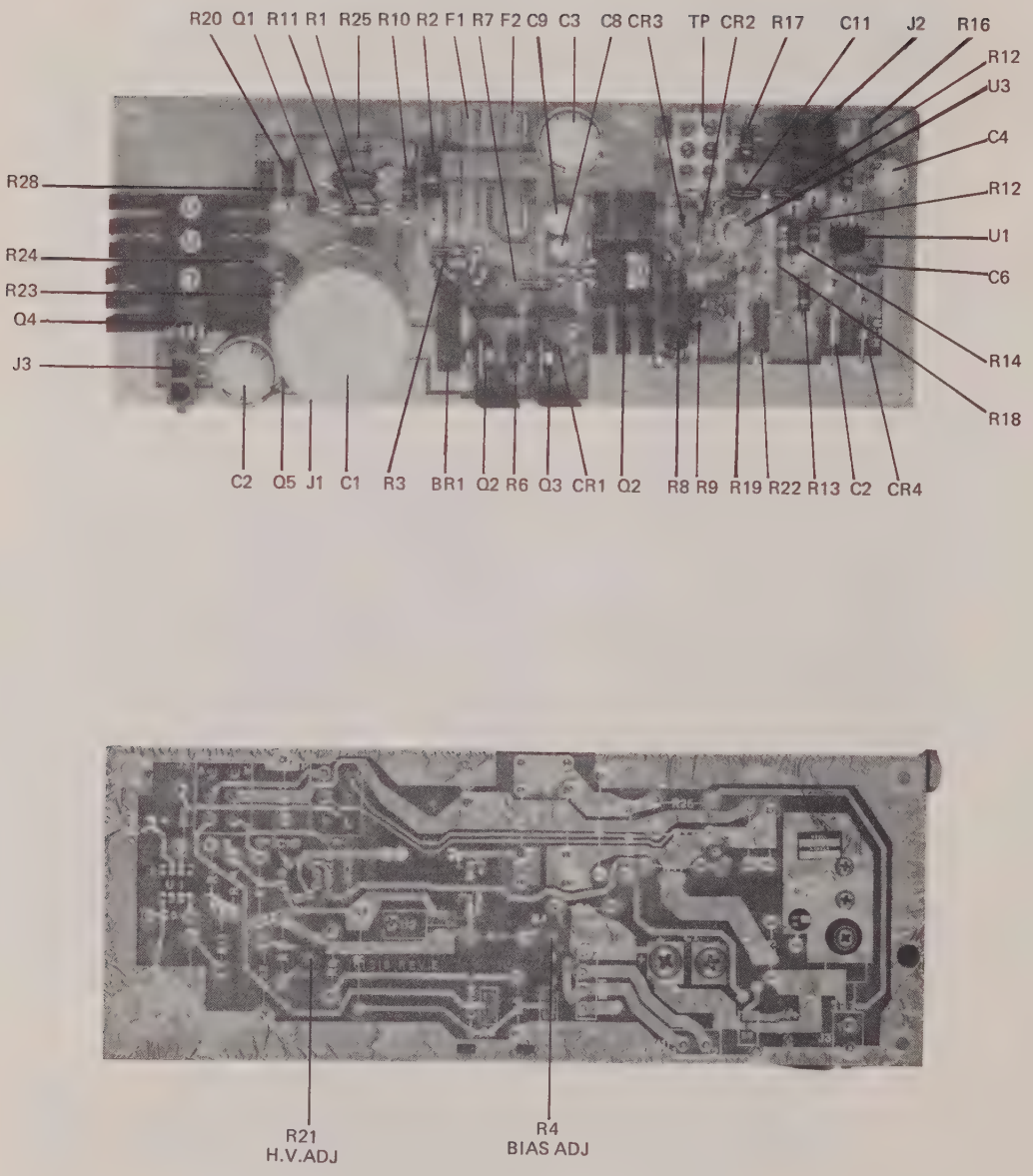


Figure 4-12. High Voltage Control Board Assembly A4, Component Layout

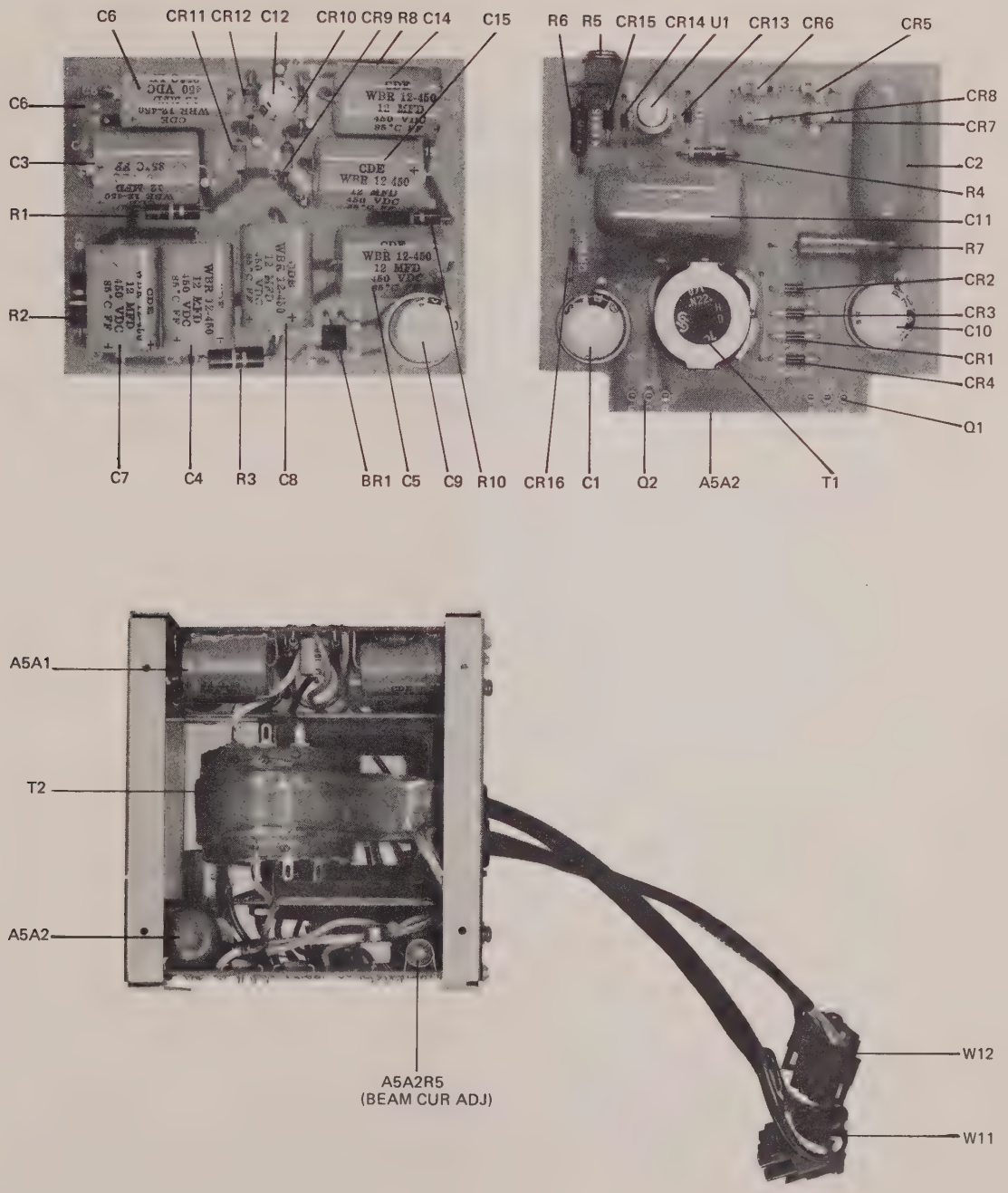


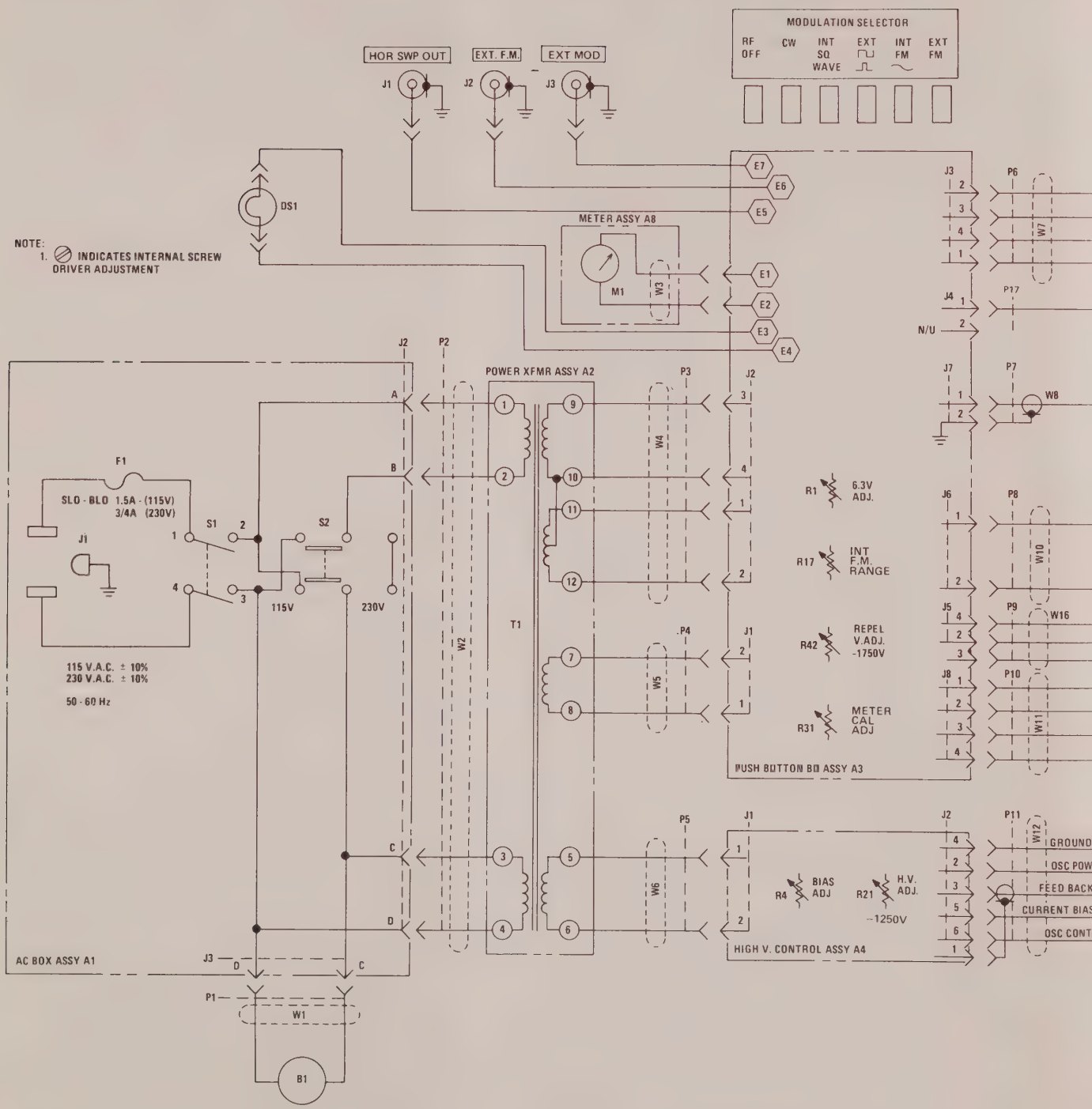
Figure 4-13. High Voltage Box Assembly A5, Component Layout

SECTION V

SCHEMATIC DIAGRAMS

5-1. GENERAL

5-2. This section contains the schematic diagrams (figures 5-1 through 5-7) and voltage and resistance measurements (table 5-1) that are essential aids in the maintenance of Models 1107E, 1108E, 1207E, and 1208E. The diagrams are to be employed in conjunction with Section III to help the technician understand the operation of the units. Both the diagrams and the voltage measurements are to be used in conjunction with Section IV to facilitate troubleshooting and maintenance operations.


MODULATION SELECTOR
RF OFF
CW
INT SQ WAVE
EXT
INT FM
EXT FM
HOR SWP OUT
EXT. F.M.
EXT MOD
J1
J2
J3
DS1
NOTE:
1. INDICATES INTERNAL SCREW DRIVER ADJUSTMENT
METER ASSY A8
M1
W3
E1
E2
E3
E4
E5
E6
E7
J3
P6
W7
J4
P17
N/U
J7
P7
W8
J6
P8
W10
J5
P9
W16
J8
P10
W11
POWER XFMR ASSY A2
P2
P3
J2
P4
J1
P5
W4
W5
W6
W2
T1
F1
SLO - BLO 1.5A - (115V)
3/4A (230V)
J1
S1
S2
115V
230V
115 V.A.C. ± 10%
230 V.A.C. ± 10%
50 - 60 Hz
R1
6.3V ADJ.
R17
INT F.M. RANGE
R42
REPEL V.ADJ. -1750V
R31
METER CAL ADJ
PUSH BUTTON BD ASSY A3
R4
BIAS ADJ
R21
H.V. ADJ.
-1250V
HIGH V. CONTROL ASSY A4
J2
P11
W12
GROUND
OSC POW
FEED BACK
CURRENT BIAS
OSC CONT
AC BOX ASSY A1
J3
P1
W1
B1

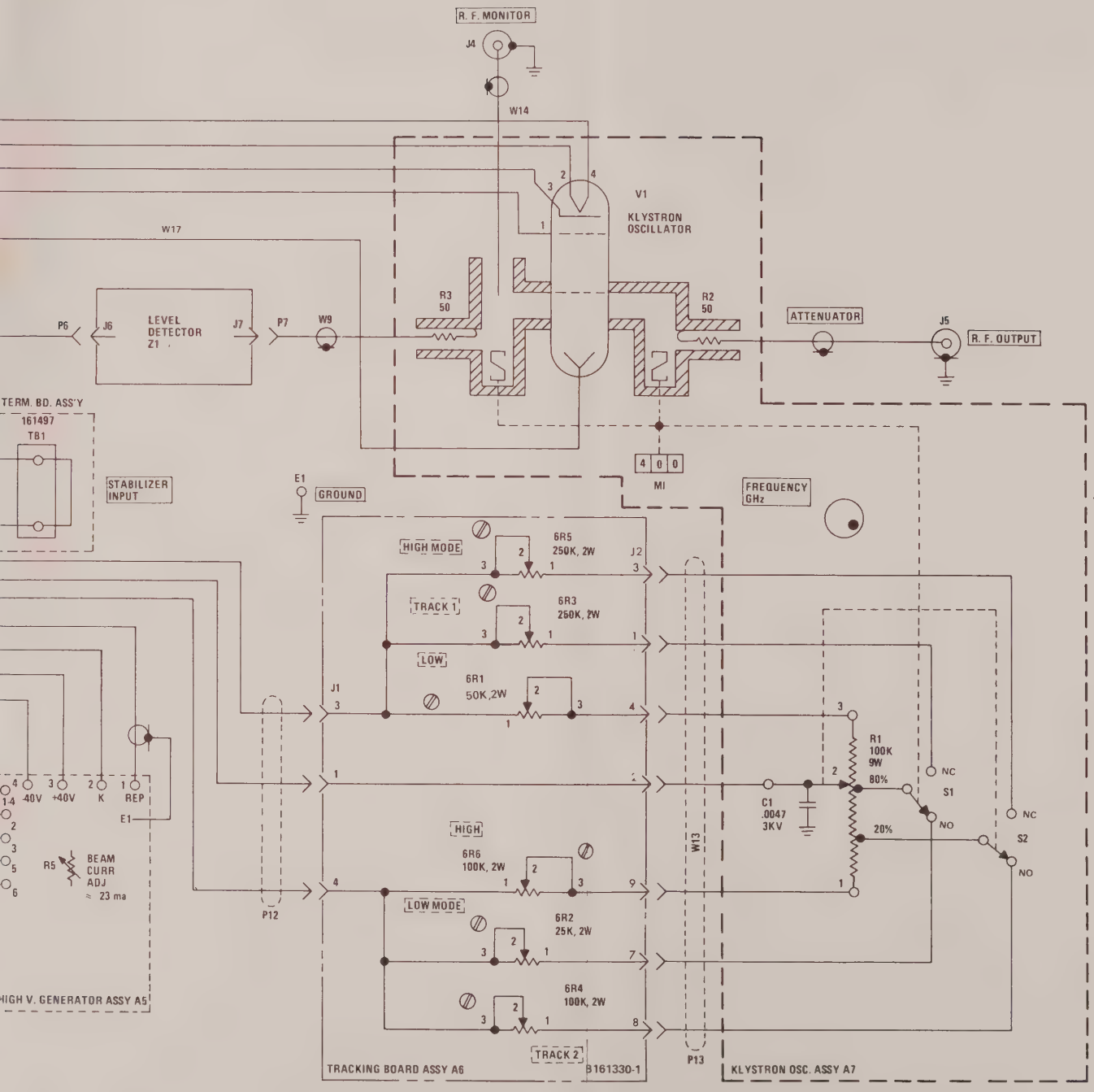
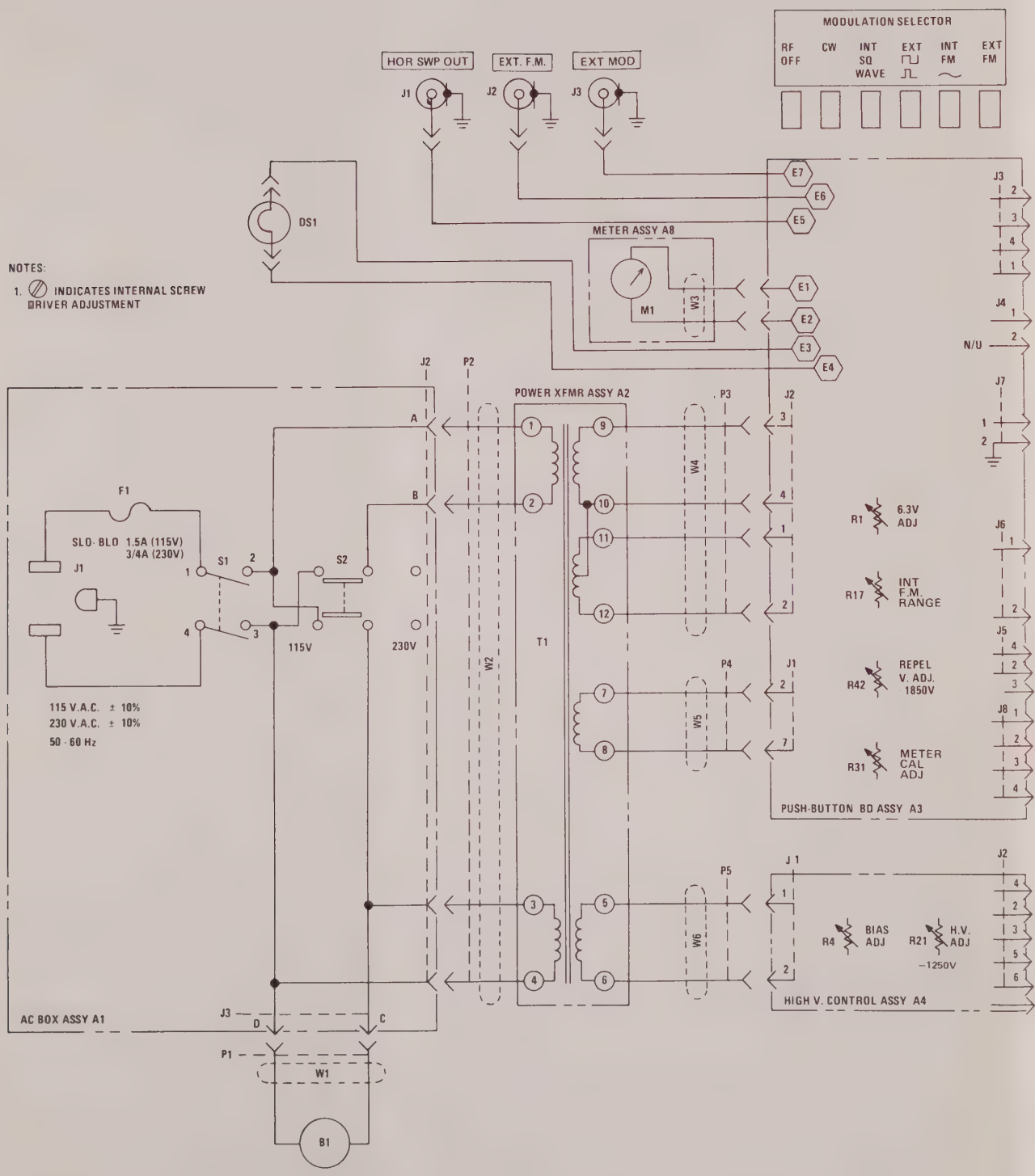


Figure 5-1. Model 1107E Modular Microwave Signal Generator, Schematic Diagram


MODULATION SELECTOR
RF OFF
CW
INT SQ WAVE
EXT
INT FM
EXT FM
HOR SWP OUT
EXT. F.M.
EXT MOD
J1
J2
J3
DS1
METER ASSY A8
M1
W3
E7
E6
E5
E1
E2
E3
E4
NOTES:
1. INDICATES INTERNAL SCREW DRIVER ADJUSTMENT
POWER XFMR ASSY A2
T1
W2
W4
W5
W6
P2
P3
P4
P5
F1
SLO-BLO 1.5A (115V)
3/4A (230V)
S1
S2
115V
230V
115 V.A.C. ± 10%
230 V.A.C. ± 10%
50 - 60 Hz
AC BOX ASSY A1
P1
W1
B1
R1 6.3V ADJ
R17 INT F.M. RANGE
R42 REPEL V. ADJ. 1850V
R31 METER CAL ADJ
PUSH-BUTTON BD ASSY A3
R4 BIAS ADJ
R21 H.V. ADJ
−1250V
HIGH V. CONTROL ASSY A4
N/U

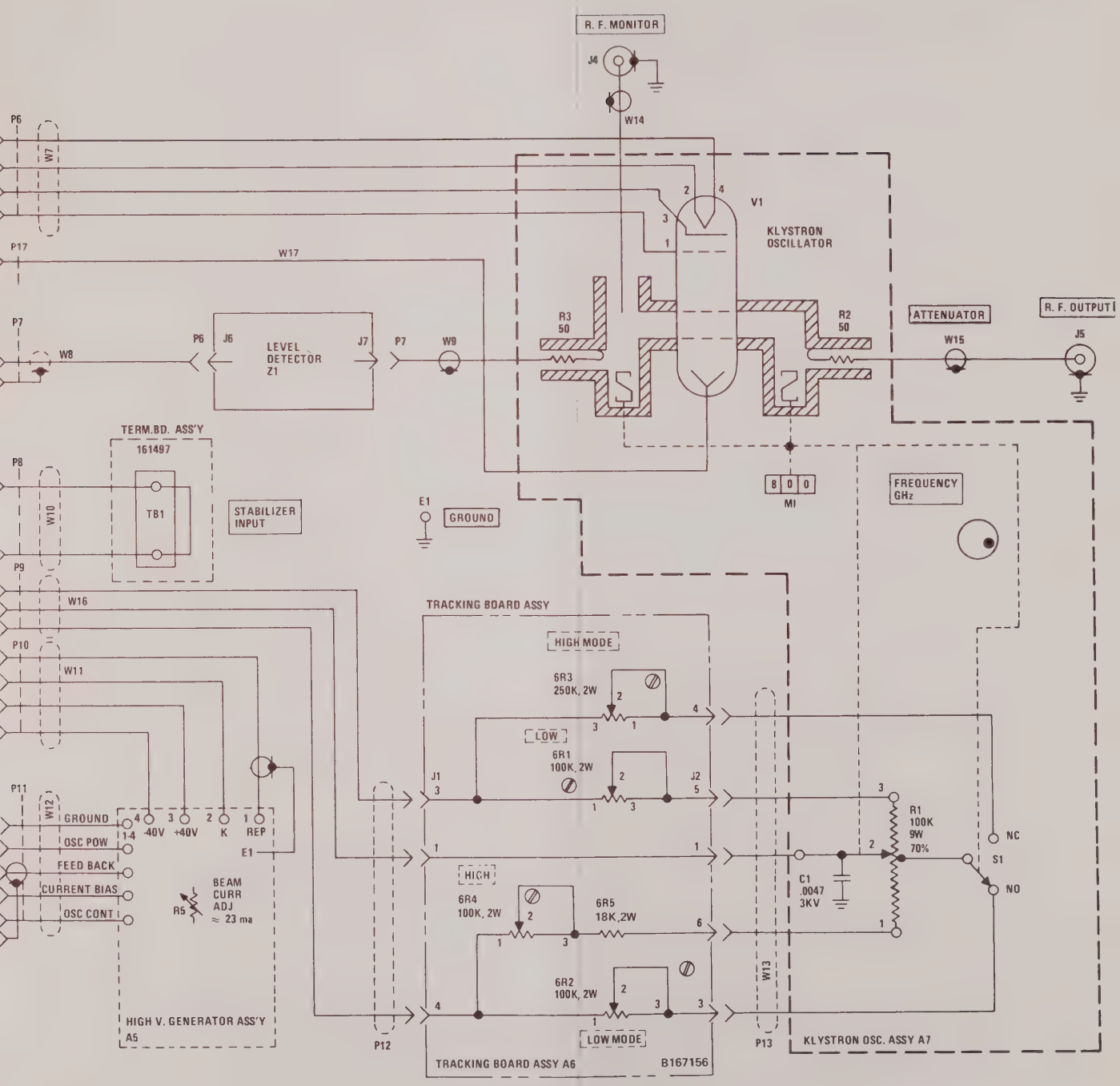
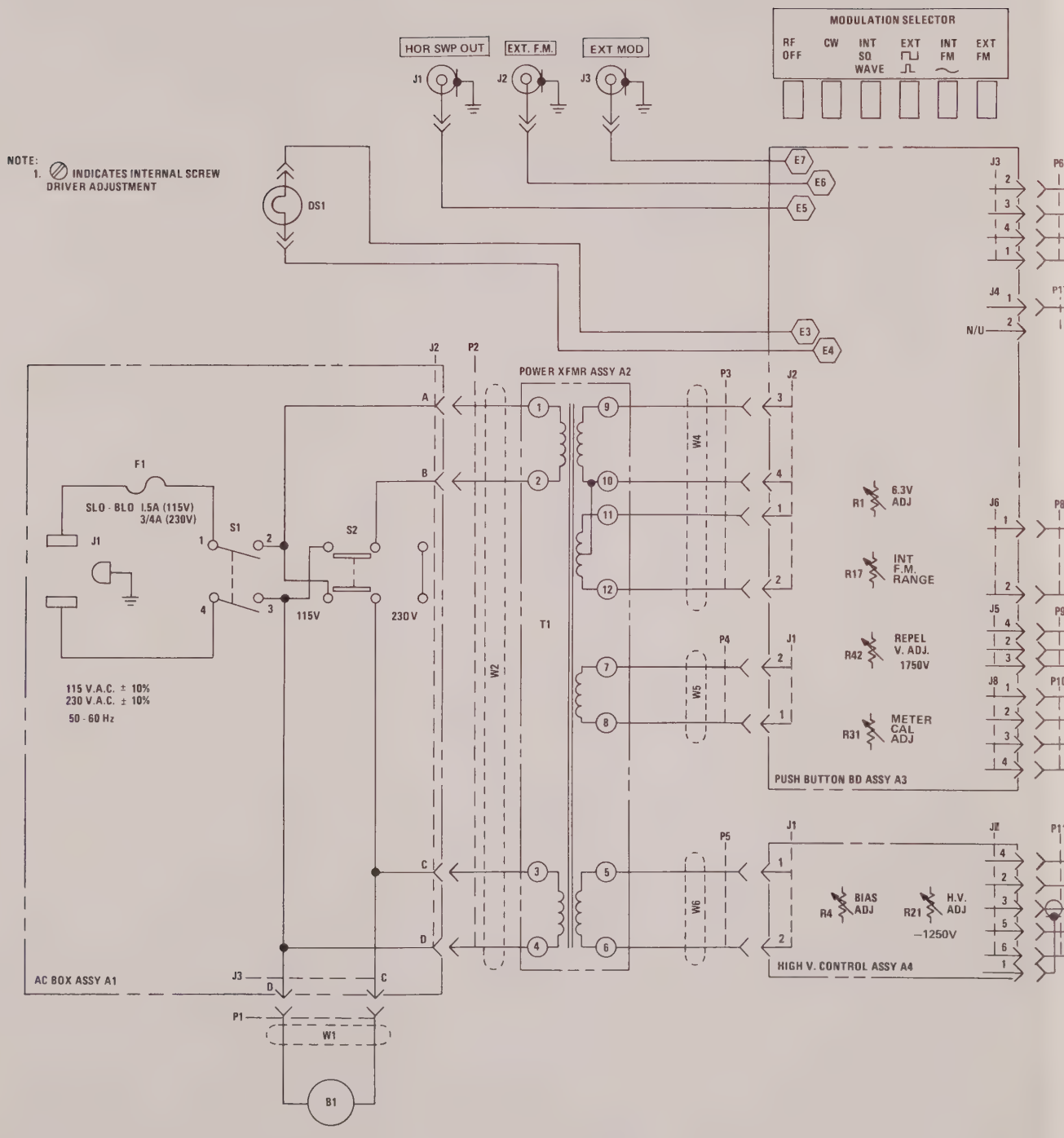


Figure 5-2. Model 1108E Modular Microwave Signal Generator, Schematic Diagram


NOTE:
1. ⊘ INDICATES INTERNAL SCREW DRIVER ADJUSTMENT
MODULATION SELECTOR
RF OFF
CW
INT SQ WAVE
EXT
INT FM
EXT FM
HOR SWP OUT
EXT. F.M.
EXT MOD
J1
J2
J3
DS1
E7
E6
E5
E3
E4
N/U
POWER XFMR ASSY A2
T1
W1
W2
W4
W5
W6
F1
SLO - BLO 1.5A (115V)
3/4A (230V)
S1
S2
115V
230V
115 V.A.C. ± 10%
230 V.A.C. ± 10%
50 - 60 Hz
R1 6.3V ADJ
R17 INT F.M. RANGE
R42 REPEL V. ADJ. 1750V
R31 METER CAL ADJ
PUSH BUTTON BD ASSY A3
R4 BIAS ADJ
R21 H.V. ADJ
−1250V
HIGH V. CONTROL ASSY A4
AC BOX ASSY A1
B1

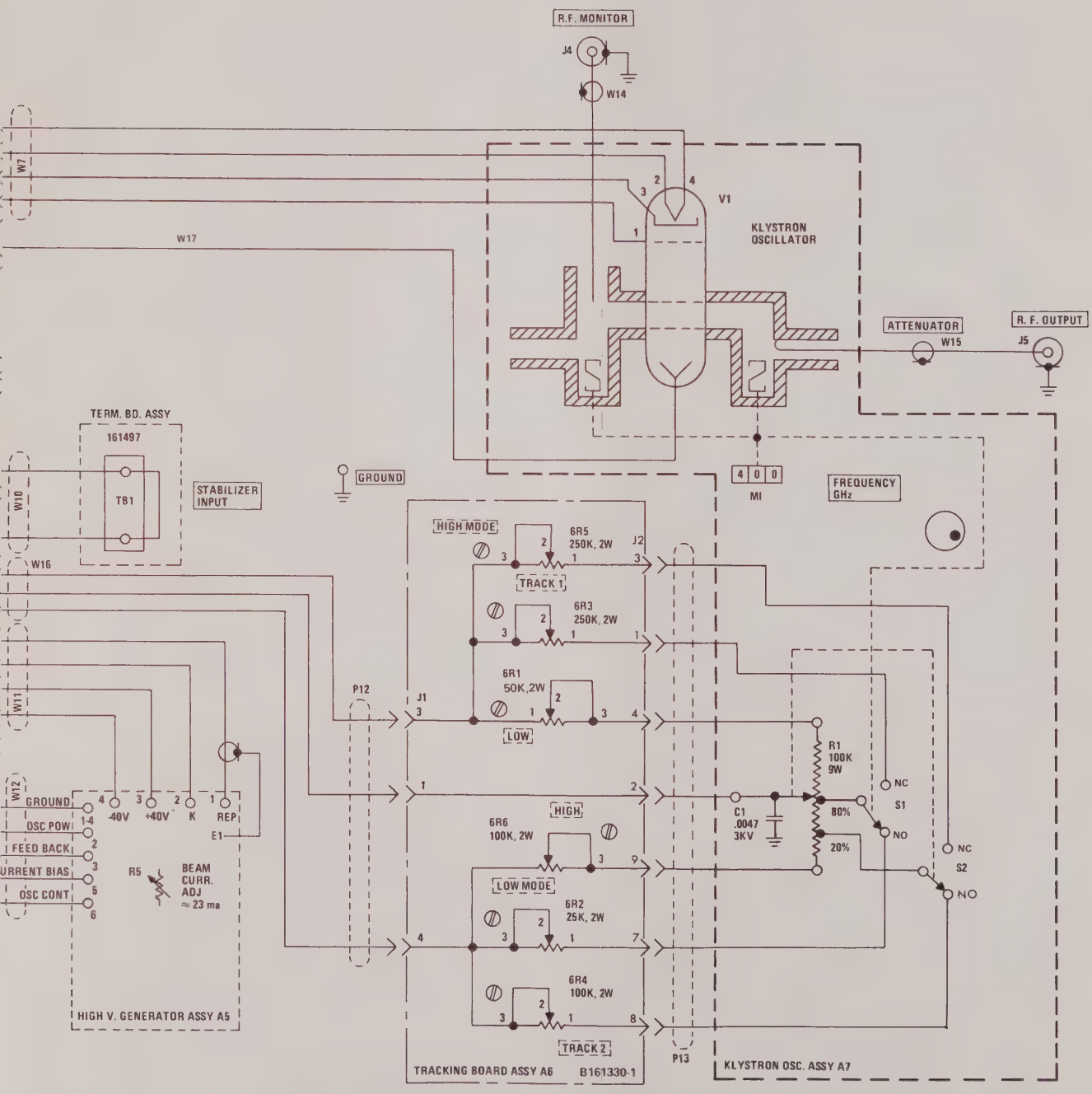
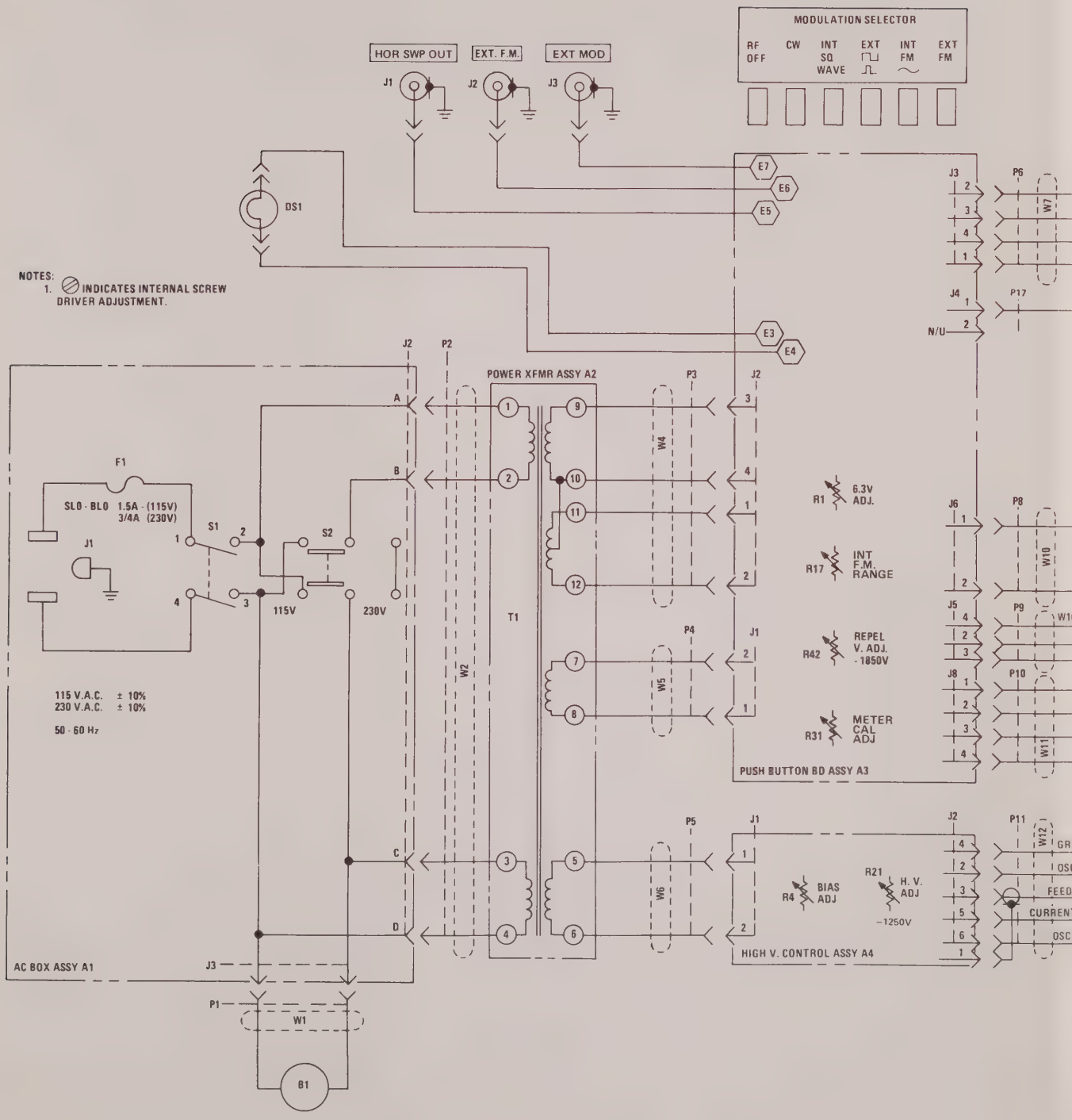


Figure 5-3. Model 1207E, Modular Microwave Signal Source, Schematic Diagram


MODULATION SELECTOR
RF OFF
CW
INT SQ WAVE
EXT
INT FM
EXT FM
HOR SWP OUT
EXT. F.M.
EXT MOD
J1
J2
J3
DS1
E7
E6
E5
E3
E4
NOTES:
1. INDICATES INTERNAL SCREW DRIVER ADJUSTMENT.
POWER XFMR ASSY A2
T1
F1
SLO - BLO 1.5A - (115V)
3/4A (230V)
S1
S2
115V
230V
115 V.A.C. ± 10%
230 V.A.C. ± 10%
50 - 60 Hz
AC BOX ASSY A1
P1
W1
B1
W2
W4
W5
W6
R1 6.3V ADJ.
R17 INT F.M. RANGE
R42 REPEL V. ADJ. -1850V
R31 METER CAL ADJ
PUSH BUTTON BD ASSY A3
R4 BIAS ADJ
R21 H. V. ADJ
-1250V
HIGH V. CONTROL ASSY A4
P6
W7
P17
N/U
P8
W10
P9
P10
W11
P11
W12
FEED
CURREN
OSC

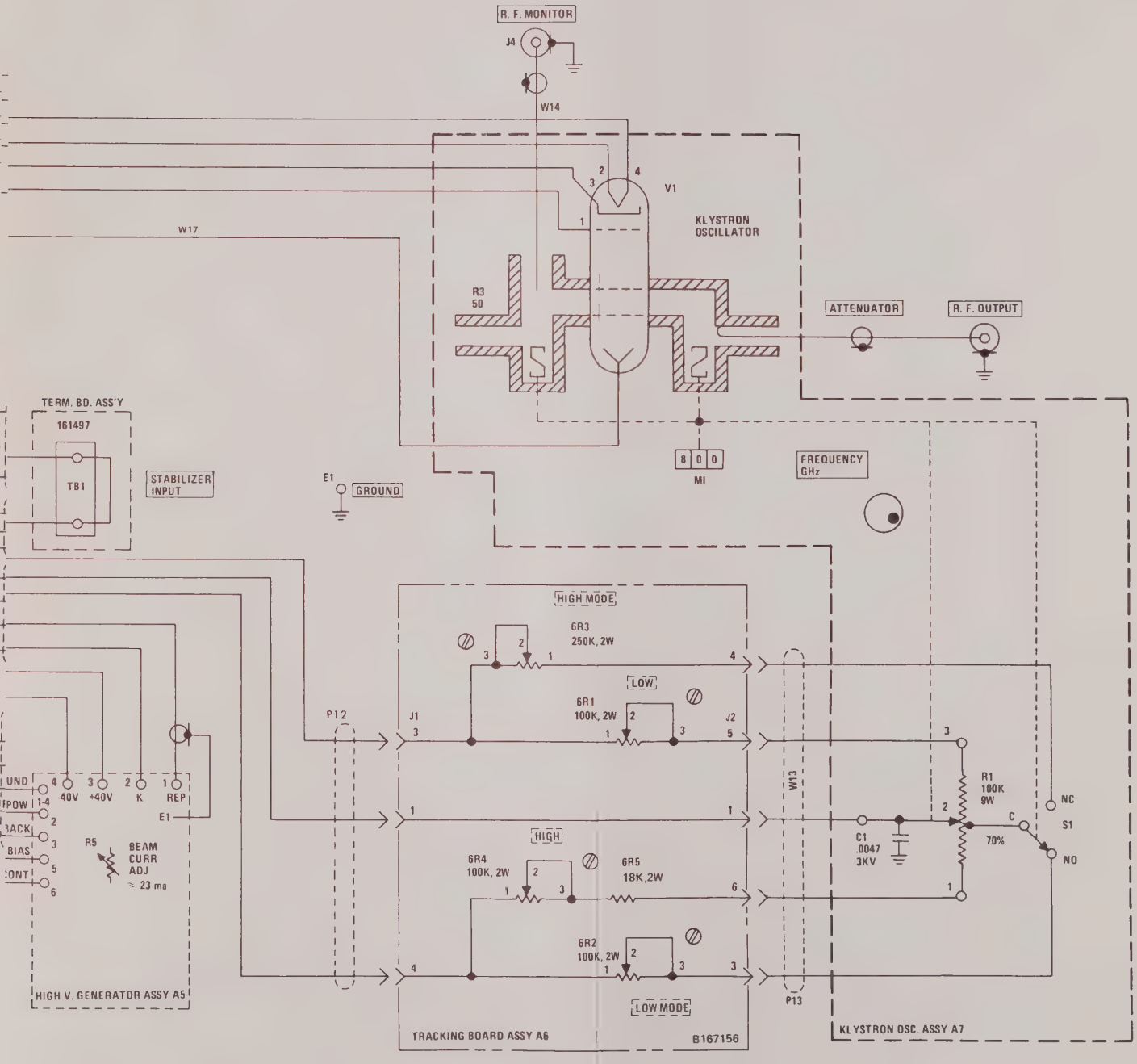
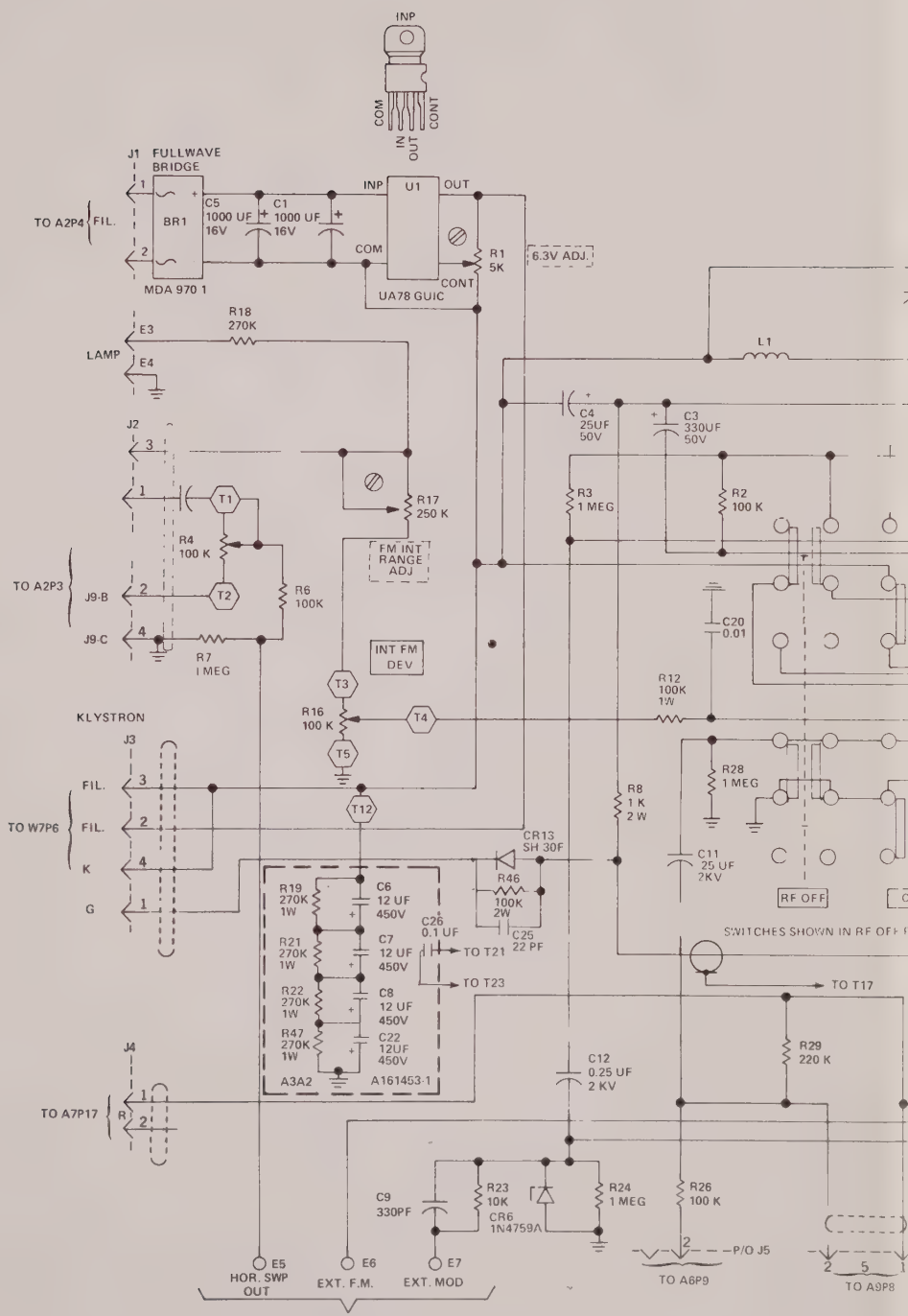
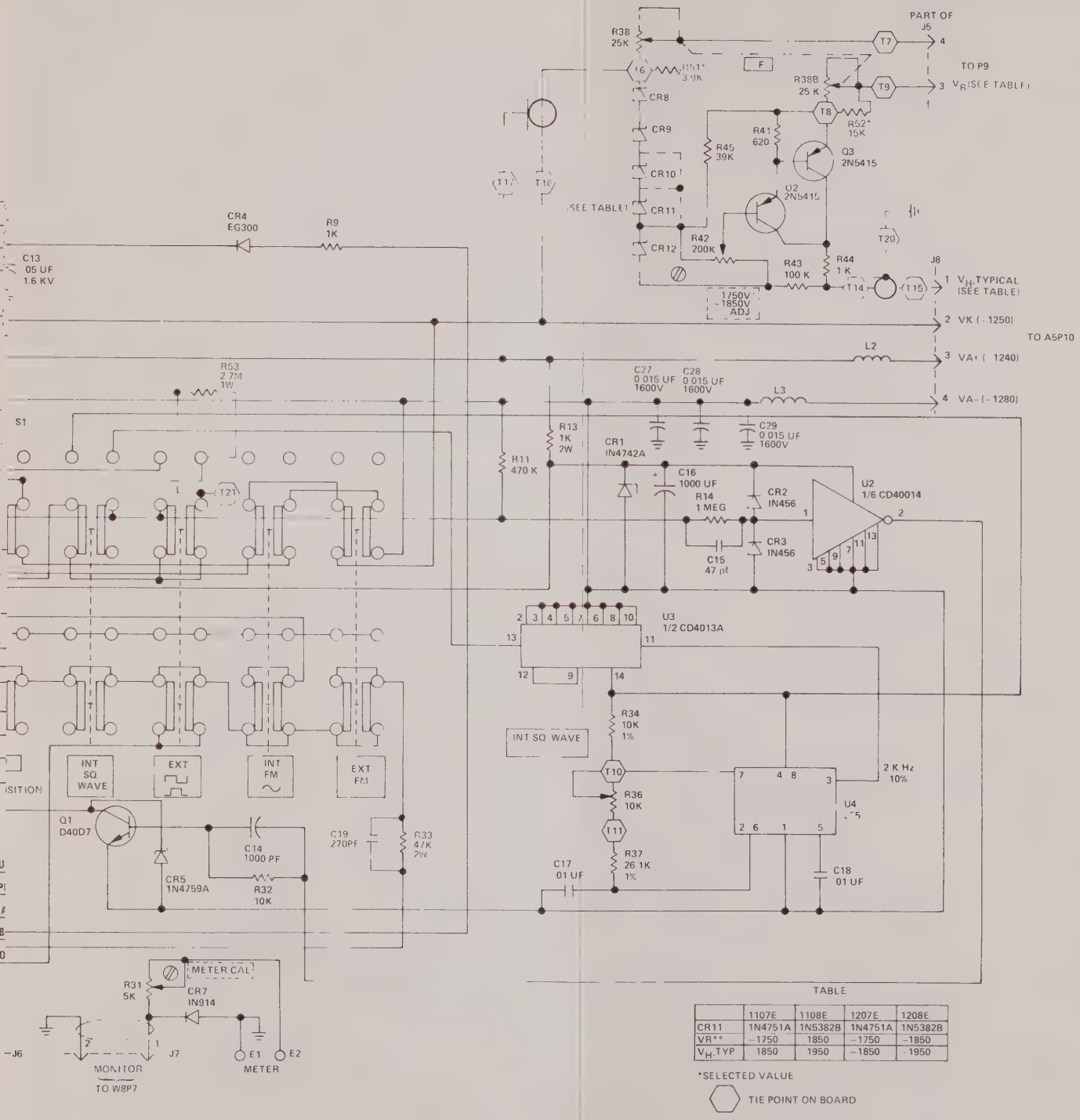


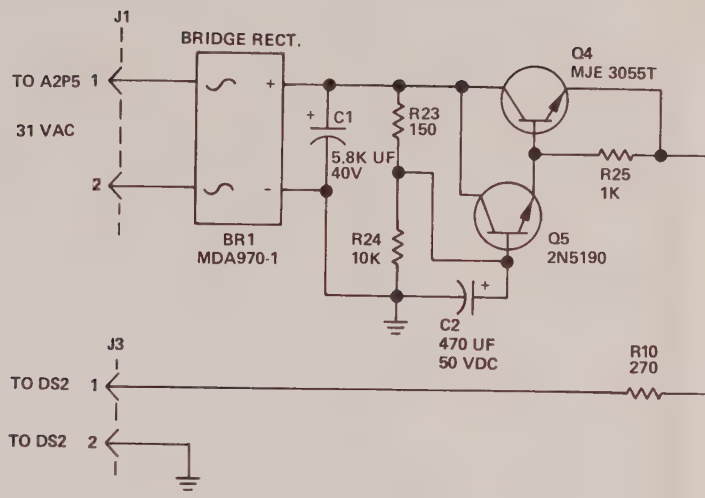
Figure 5-4. Model 1208E, Modular Microwave Signal Source, Schematic Diagram

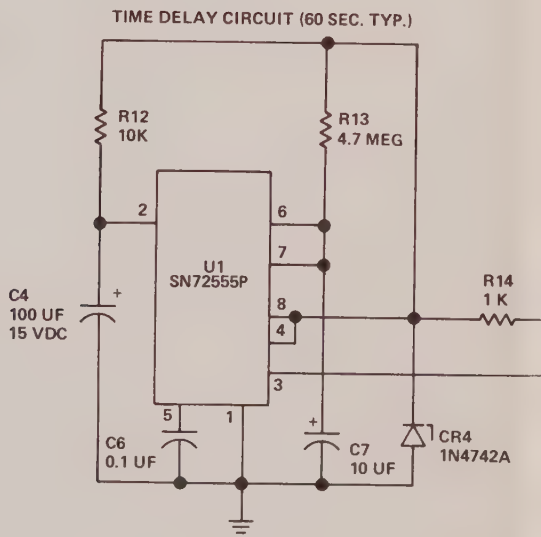

INP
COM
IN
OUT
CONT
J1
FULLWAVE BRIDGE
TO A2P4
FIL.
BR1
MDA 970 1
C5 1000 UF 16V
C1 1000 UF 16V
U1
INP
OUT
COM
CONT
UA78 GUIC
R1 5K
6.3V ADJ.
R18 270K
E3
LAMP
E4
L1
C4 25UF 50V
C3 330UF 50V
J2
R17 250 K
R3 1 MEG
R2 100 K
T1
R4 100 K
FM INT RANGE ADJ
TO A2P3
J9-B
J9-C
T2
R6 100K
R7 1 MEG
C20 0.01
INT FM DEV
T3
T4
T5
R16 100 K
R12 100K 1W
KLYSTRON
J3
FIL.
TO W7P6
FIL.
K
G
T12
R8 1 K 2 W
R28 1 MEG
CR13 SH 30F
C11 25 UF 2KV
RF OFF
R19 270K 1W
R21 270K 1W
R22 270K 1W
R47 270K 1W
C6 12 UF 450V
C7 12 UF 450V
C8 12 UF 450V
C22 12UF 450V
A3A2
A161453-1
C26 0.1 UF
TO T21
TO T23
R46 100K 2W
C25 22 PF
SWITCHES SHOWN IN RF OFF
TO T17
J4
TO A7P17
R
C12 0.25 UF 2 KV
R29 220 K
C9 330PF
R23 10K
CR6 1N4759A
R24 1 MEG
R26 100 K
P/O J5
TO A6P9
TO A9P8
E5 HOR. SWP OUT
E6 EXT. F.M.
E7 EXT. MOD



	1107E	1108E	1207E	1208E
CR11	1N4751A	1N5382B	1N4751A	1N5382B
VR**	-1750	1850	-1750	-1850
V_H TYP	1850	1950	-1850	-1950

Figure 5-5. Pushbutton Board Assembly A3, Schematic Diagram


J1
BRIDGE RECT.
TO A2P5 1
31 VAC
2
+
-
C1
5.8K UF
40V
R23
150
Q4
MJE 3055T
R25
1K
BR1
MDA970-1
R24
10K
Q5
2N5190
C2
470 UF
50 VDC
J3
TO DS2 1
TO DS2 2
R10
270


TIME DELAY CIRCUIT (60 SEC. TYP.)
R12
10K
R13
4.7 MEG
2
6
7
U1
SN72555P
8
4
3
5
1
C4
100 UF
15 VDC
R14
1 K
C6
0.1 UF
C7
10 UF
CR4
1N4742A

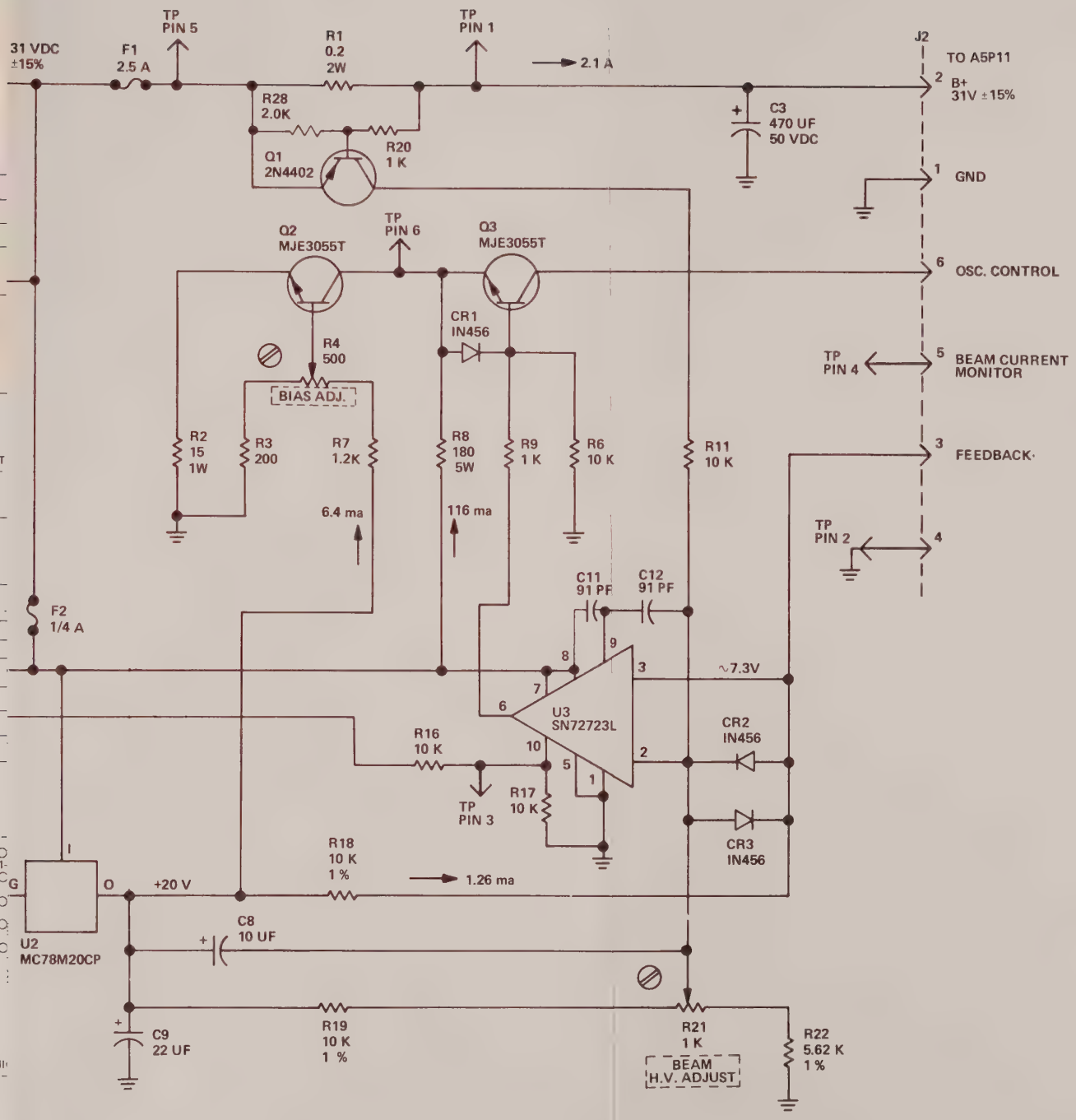
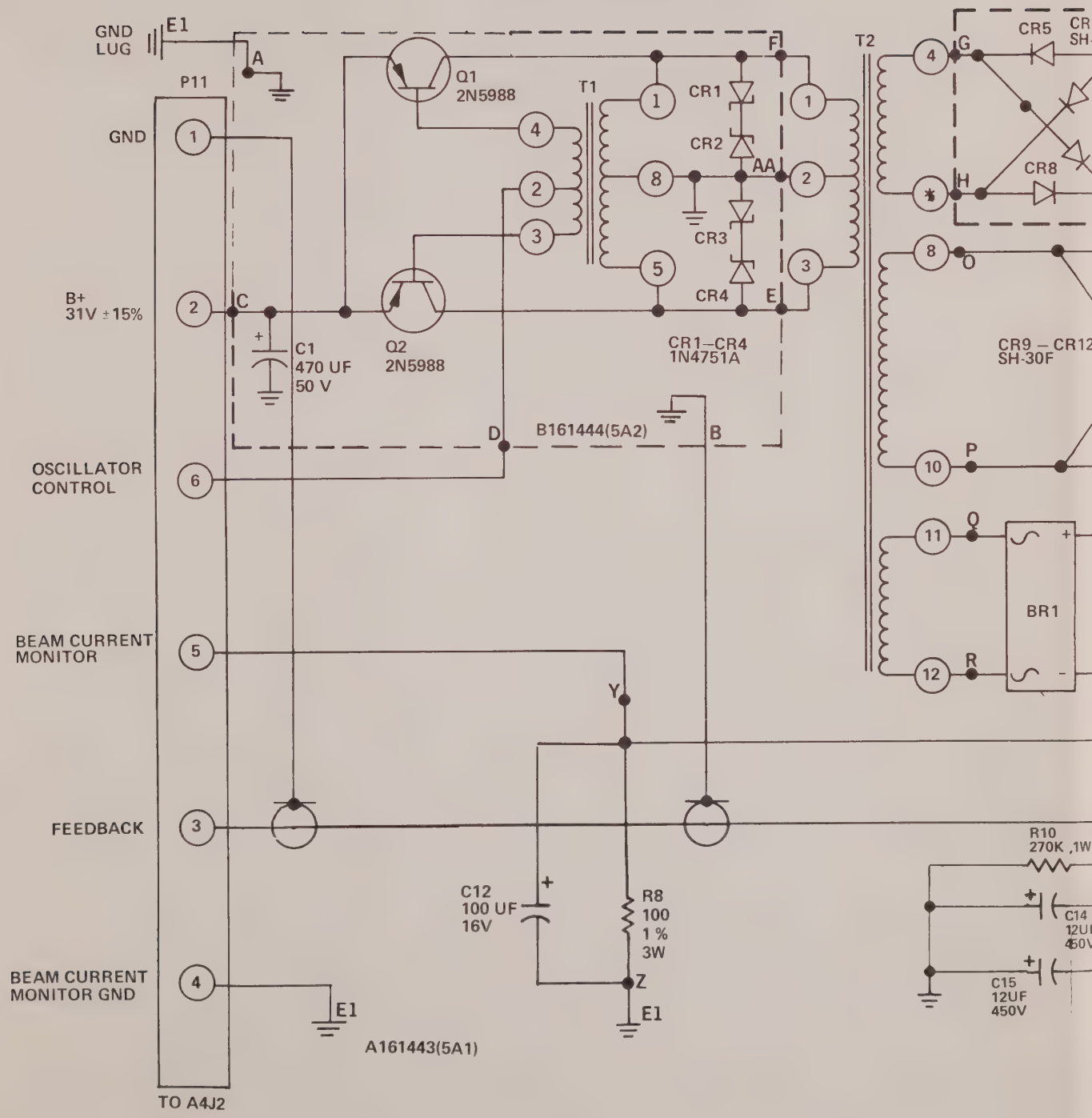
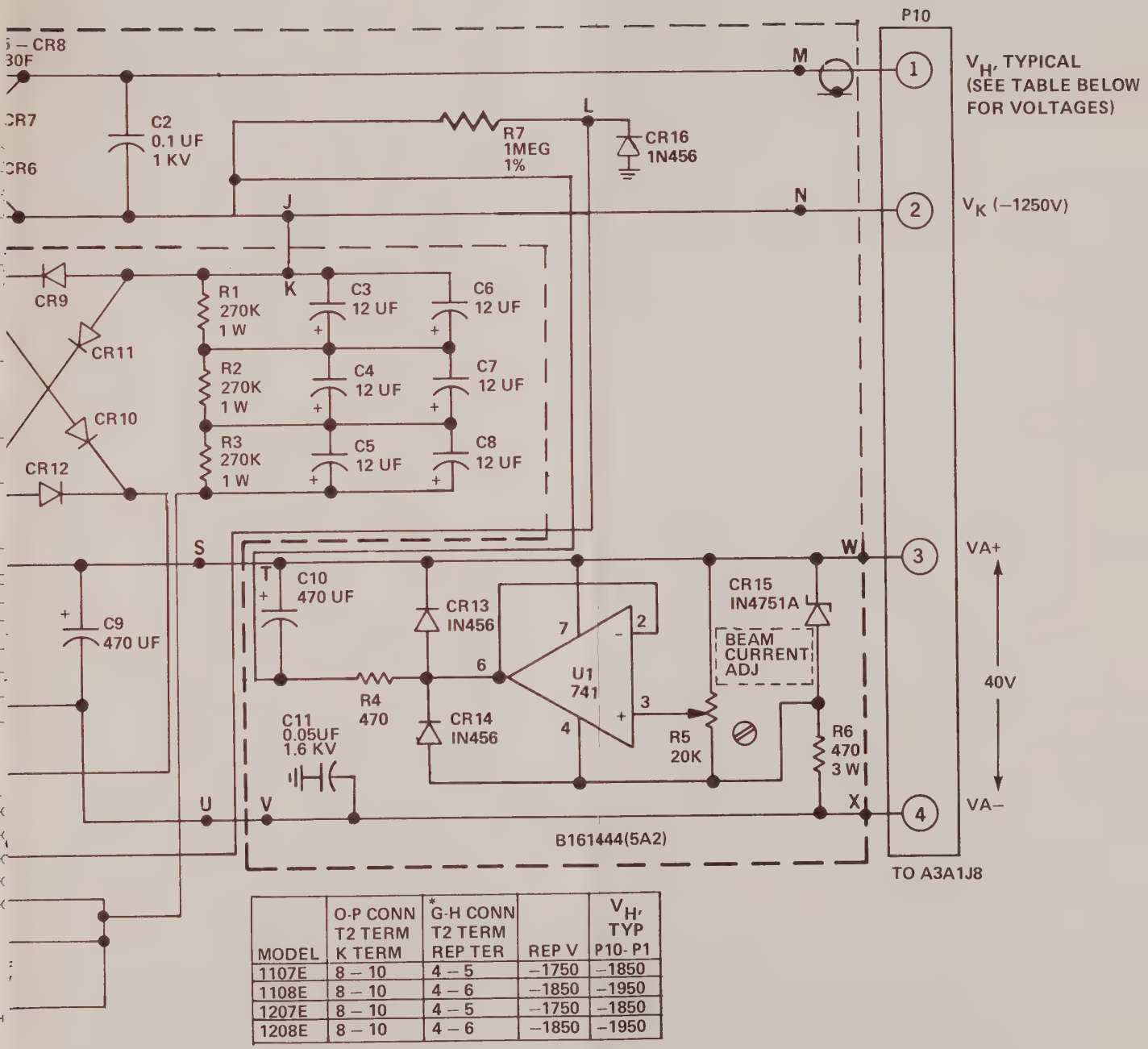


Figure 5-6. High Voltage Control Board Assembly A4, Schematic Diagram


GND LUG
E1
A
P11
GND
1
B+ 31V ±15%
2
C
C1 470 UF 50 V
OSCILLATOR CONTROL
6
BEAM CURRENT MONITOR
5
FEEDBACK
3
BEAM CURRENT MONITOR GND
4
E1
TO A4J2
Q1 2N5988
Q2 2N5988
T1
T2
CR1
CR2
CR3
CR4
CR1–CR4 1N4751A
CR5
CR8
CR9 – CR12 SH-30F
B161444(5A2)
D
B
F
E
AA
G
H
O
P
Q
R
BR1
Y
Z
C12 100 UF 16V
R8 100 1 % 3W
R10 270K ,1W
C14 12UF 450V
C15 12UF 450V
A161443(5A1)



MODEL	O-P CONN T2 TERM K TERM	*G-H CONN T2 TERM REP TER	REP V	V_H, TYP P10- P1
1107E	8 – 10	4 – 5	–1750	–1850
1108E	8 – 10	4 – 6	–1850	–1950
1207E	8 – 10	4 – 5	–1750	–1850
1208E	8 – 10	4 – 6	–1850	–1950

Figure 5-7. High Voltage Box Assembly A5, Schematic Diagram

TABLE 5-1. VOLTAGE AND RESISTANCE MEASUREMENTS

SYMBOL	PART NO.	PIN NUMBERS 1 (E)	2 (B)	3 (C)	4	5	6	7	8	9	10	11	12	13	14	UNITS
PUSHBUTTON BOARD ASSEMBLY																
A3A1Q1	D40D7	0	0	+40												Volts
A3A1U2	CD40014P	3K	3.5K	0	3.5K	0	3.5K	0	3.5K	0	3.5K	0	3.5K	0	2K	Ohms
A3A1U3	CD4013AE	3.5K	0	0	0	0	0	0	0	3K	0	2.5K	3K	3K	2K	Ohms
A3A1U4	SN7255P	0	3K	2K	2K	5K	3K	2.5K	2K							Ohms
MODEL 1108E/1208E ONLY																
A3A1J3	350430-1	+11[a]	+6	0	0											Volts
A3A1J4	350786-1	-378[b]	N.C	–	–											Volts
A3A1J5	350792-1	N.C.	-209[b]	-578[b]	-16[b]											Volts
A3A1J6	350786-1	-378[b]	-378[b]	–	–											Volts
A3A1J8	350792-1	-770[b]	0	+17[a]	-24[a]											Volts
MODEL 1107E/1207E ONLY																
A3A1J3	350430-1	+9[a,b]	+6	0	0											Volts
A3A1J4	350786-1	-360[b]	N.C	–	–											Volts
A3A1J5	350792-1	N.C.	-365[b]	-478[b]	-17[b]											Volts
A3A1J6	350786-1	-360[a,b]	-360[a,b]	–	–											Volts
A3A1J8	350792-1	-648[a]	0	+17[a]	-23[a]											Volts

Note: a. Varies from klystron to klystron.
b. Varies from klystron to klystron with frequency.
c. Measurements taken at 7.00 GHz.
d. Connect Fluke Model 8000A Differential Voltmeter Common Lead to Pin 2 of A3A1J8

TABLE 5-1. VOLTAGE AND RESISTANCE MEASUREMENTS

SYMBOL	IC/TRANS	PIN NUMBERS 1 (E)	2 (B)	3 (C)	4	5	6	7	8	9	10	11	12	13	14	
HIGH VOLTAGE CONTROL BOARD ASSEMBLY																
A4BR1	MDA970-1	25(+)	0(−)													Ohms
		+32.3	0													Volts
A4Q1	2N4402	0.3K	1.2K	15K												Ohms
		+30.1	+29.9	+7.4												Volts
A4Q2	MJE3055T	15	200	45												Ohms
		+2.0	+2.6	+10.1												Volts
A4Q3	MJE3055T	45	250	35												Ohms
		+10.0	+10.6	+32.0												Volts
A4Q4	MJE3055T	0.3K	1.3K	1K												Ohms
		+30.4	+31.2	+32.3												Volts
A4Q5	2N5190	600	450	100												Ohms
		+31.2	+31.8	+32.3												Volts
A4U1	SN7255P	0	15	8	7	3.5K	2.5K	2.5K	7							Ohms
		0	+11.7	0	+11.7	+7.8	0	0	+11.7							Volts
A4U2	MC78M20	12(I)	1.5K(0	0(G)												Ohms
		+29.8	+19.9	0												Volts
A4U3	SN72723L	0	4K	3K	3.5K	0	3K	0.3K	0.3K	3.5K	7K					Ohms
		0	+7.4	+7.4	+7.4	0	+11.6	+29.8	+29.8	+12.6	0					Volts
HIGH VOLTAGE BOX ASSEMBLY																
A5Q1	2N5988	15	4	0												Ohms
		+32.0	+32.6	0												Volts
A5Q2	2N5988	15	4	0												Ohms
		+32.0	+32.6	0												Volts
A5A2U1	SN7241L	2K	3.5K	6K	0.4K	2K	3.5K	2.5K	∞							Ohms
		Do not attempt voltage measurements as high voltages are present.														

Note:
1. Measurements taken with Fluke Model 8000A Diiferential Voltmeter and Triplett Model 630A Voltmeter
2. — COMMON lead attached to chassis GND
3. MODULATION SELECTOR switch in CW position

SECTION VI

PARTS LIST

6-1. INTRODUCTION

6-2. This parts list provides an alpha-numerical listing in reference symbol sequence of the replaceable electrical, certain electro-mechanical, and mechanical parts of the unit.

6-3. ORDERING INFORMATION. Orders for parts should contain the following information:

a. Equipment name and model number.
b. Serial number.
c. Reference symbol of part, if applicable.
d. Manufacturer's part number and code.

6-4. HOW TO USE THE PARTS LIST

6-5. An explanation of the structure of the parts list,Table 6-2, and the meaning of the entries in the five columns are given in the following paragraphs. (See Figure 6-1.)

6-6. REFERENCE SYMBOL COLUMN. The reference symbol column (1,Figure 5-1) contains the reference symbol number assigned to each part, which also identifies the part on the schematic diagram or illustration. The listing is in alpha-numerical order.

6-7. DESCRIPTION COLUMN. The description column (2) contains a brief description of each part.

6-8. MANUFACTURER'S PART NUMBER COLUMN. The manufacturer's part number column (3) contains the part number assigned by the manufacturer of the part.

6-9. MANUFACTURER'S CODE COLUMN. The manufacturer's code column contains a five digit code identifying the manufacturer of the part. Table 6-1 contains a listing of the five digit codes and the manufacturer's names and addresses.

6-10. QUANTITY COLUMN. The quantity column (5) indicates the quantity of each part contained in the respective assembly or subassembly of the instrument.

1 2 3 4 5

TABLE 6-2. PARTS LIST

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	QTY
1A1	HARMONIC GENERATOR	B169999	82199	1
1A2R6	RESISTOR,FIXED,COMPOSITION,1K,5%,½W	RC20GF102J	81349	2
1A2R7	SAME AS 1A2R6			

Figure 6-1. Parts List Example

TABLE 6-1. MANUFACTURER'S CODE

Code	Name and Address
00779	AMP Inc. Harrisburg, Pa. 17105
01121	Allen Bradley Co. Milwaukee, Wisc 53204
01295	Texas Instrument Inc. Semiconductor and Components Div. Dallas, Texas 75231
04713	Motorola Semiconductor Products,Inc. Phoenix, Ariz 85008
09214	General Electric Co. Semi-Conductor Products Dept. Auburn, N.Y. 31022
12697	Clarostat Mfg. Co. Dover, N.H. 03820
13715	Fairchild Camera & Instrument Corp. Semiconductor Div. San Rafael, Calif. 94902
14099	Semtech Corp. Newbury Park, Calif. 91320
14655	Cornell-Dubilier Electric Co. Newark, N.J. 07105
16727	Condensor Products Corp. Brooksville, Fla. 33512
37942	P.R.Mallory and Co. Indianaplolis, Ind. 46206
44655	Ohmite Mfg. Co. Skokie, Ill. 60076
56289	Sprague Electric Co. North Adams, Mass. 01247
63472	Ward Leonard Electric Co. Mt. Vernon, N.Y. 10550
71590	Centralab Div. Globe Union, Inc. Milwaukee, Wis. 53201
72982	Erie Technological Products,Inc. Erie, Pa. 16512
73138	Beckman Instruments, Inc. Helipot Div. Fullerton, Calif. 92634
73445	Amperex Electronic Corp. Hicksville, N.Y. 11801
75042	IRC Div. of TRW Inc. Philadelphia, Pa. 19108
75915	Littelfuse Inc. Des Plaines, Ill. 60016
81312	Winchester Electronics Div. Oakville, Conn.
81349	Military Specifications
82199	Polarad Electronics Corp. Lake Success,N.Y. 11040
82389	Switchcraft, Inc. Chicago, Ill. 60630
83701	Electronic Devices Inc. Yonkers, N.Y. 10710
84411	TRW Capacitor Div. Ogallala, Nebr.
92702	IMC Magnetics Corp. Westbury, N.Y. 11591

TABLE 6-2 PARTS LIST

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	QTY
	MODELS 1107E AND 1108E SIGNAL GENERATORS MODELS 1207E AND 1208E SIGNAL SOURCES			
A1	**AC BOX ASSEMBLY**	**C161442**	**82199**	**1**
A1F1	FUSE, CARTRIDGE	31301.5	75915	1
A1J1	CONNECTOR, RECEPTACLE	EAC-301	82389	1
A1J2	CONNECTOR, RECEPTACLE	M4S-LRN	81312	2
A1J3	SAME AS A1J2			
A1S1	SWITCH, ROTARY	20BE	71590	1
A1S2	SWITCH, SLIDE	46206LF-1	82389	1
A1XF1	FUSEHOLDER	342004	75915	1
A2	**POWER TRANSFORMER ASSEMBLY**	**C161454**	**82199**	**1**
A2P2	CONNECTOR,PLUG	M4P-LSH10	81312	1
A2P3	CONNECTOR,PLUG	1-480702-0	00779	1
A2P4	CONNECTOR,PLUG	1-480698-0	00779	2
A2P5	SAME AS A2P4			
A2T1	TRANSFORMER,POWER	C161312	82199	1
A3	**PUSHBUTTON BOARD ASSY(1108E,1208E)**	**D161602-2**	**82199**	**1**
A3	**PUSHBUTTON BOARD ASSY(1107E,1207E)**	**D161602-3**	**82199**	**1**
A3A1	**PUSHBUTTON BD COMP ASSY(1108E,1208E)**	**C161608-1**	**82199**	**1**
A3A1	**PUSHBUTTON BD COMP ASSY(1107E,1207E)**	**C161608-2**	**82199**	**1**
A3A1BR1	RECTIFIER, BRIDGE	MDA970-1	04713	1
A3A1C1	CAPACITOR, ELECTROLYTIC, 1000 UUF, 16VDCW	503D-108G016ER	56289	3
A3A1C2	CAPACITOR, MYLAR, 0.1 UF, 10%, 100 VDCW	PMG1000-2A	73445	1
A3A1C3	CAPACITOR, ELECTROLYTIC, 330 UF, 50 VDCW	VTT330UF	37942	1
A3A1C4	CAPACITOR, ELECTROLYTIC,25 UF, 50 VDCW	30D256G0.50CC0	56289	1
A3A1C5	SAME AS A3A1C1			
A3A1C6 THRU A3A1C8	NOT USED			
A3A1C9	CAPACITOR, CERAMIC,330 UUF,100 VDCW	DD-331	14655	1
A3A1C10	NOT USED			
A3A1C11	CAPACITOR, PAPER, 0.25 UF, 2K VDCW	B161743	82199	2
A3A1C12	SAME AS A3A1C11			
A3A1C13	CAPACITOR, MYLAR, 0.05 UF, 1600 VDCW	16PS-S50	56289	1
A3A1C14	CAPACITOR, CERAMIC, 0.001 UF, 100 VDCW	DD-102	14655	1
A3A1C15	CAPACITOR, CERAMIC, 47 UUF	DD-470	14655	1
A3A1C16	SAME AS A3A1C1			
A3A1C17	CAPACITOR, MYLAR,0.01 UF, 1%, 100 VDCW	663-UW,1%	84411	1
A3A1C18	CAPACITOR, FILM, 0.1 UF	PMG1001-A	73445	1
A3A1C19	CAPACITOR, CERAMIC, 270 UUF	DD271	14665	1
A3A1C20	CAPACITOR, CERAMIC, 0.01 UF, 600 VDCW	811-000-2540-103M	72982	1
A3A1C21 THRU A3A1C24	NOT USED			
A3A1C25	CAPACITOR, CERAMIC, 22 PF	DD30-220	14655	1
A3A1C26	NOT USED			
A3A1C27	CAPACITOR, CERAMIC, 0.015 UF, +80%, -20% 1600 VDCW	DD16-153	14655	3
A3A1C28	SAME AS A3A1C27			

TABLE 6-2 PARTS LIST

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	QTY
A3A1C29	SAME AS A3A1C27			
A3A1CR1	SEMICONDUCTOR DEVICE, DIODE	1N4742A	81349	1
A3A1CR2	SEMICONDUCTOR DEVICE, DIODE	1N456	81349	2
A3A1CR3	SAME AS A3A1CR2			
A3A1CR4	SEMICONDUCTOR DEVICE, DIODE	EG300	83701	1
A3A1CR5	SEMICONDUCTOR DEVICE, DIODE	1N4759A	81349	2
A3A1CR6	SAME AS A3A1CR5			
A3A1CR7	SEMICONDUCTOR DEVICE, DIODE	1N914	81349	1
A3A1CR8	SEMICONDUCTOR DEVICE, DIODE	1N5382B	81349	3
A3A1CR9	SAME AS A3A1CR8			
A3A1CR10	SAME AS A3A1CR8			
A3A1CR11	SEMICONDUCTOR DEVICE, DIODE (1107E, 1207E)	1N4751A	81349	1
A3A1CR11	SEMICONDUCTOR DEVICE, DIODE (1108E, 1208E)	1N5382B	81349	1
A3A1CR12	SEMICONDUCTOR DEVICE, DIODE	1N4762A	81349	1
A3A1CR13	SEMICONDUCTOR DEVICE, DIODE	SH30F	14099	1
A3A1J1	CONNECTOR, RECEPTACLE	350428-1	00779	4
A3A1J2	CONNECTOR, RECEPTACLE	350430-1	00779	4
A3A1J3	SAME AS A3A1J2			
A3A1J4	SAME AS A3A1J1			
A3A1J5	SAME AS A3A1J2			
A3A1J6	SAME AS A3A1J1			
A3A1J7	SAME AS A3A1J1			
A3A1J8	SAME AS A3A1J2			
A3A1L1	CHOKE	A161462	82199	3
A3A1L2, L3	SAME AS A3A1L1			
A3A1Q1	TRANSISTOR	D40D7	09214	1
A3A1Q2	TRANSISTOR	2N5415	81349	2
A3A1Q3	SAME AS A3A1Q2			
A3A1R1	RESISTOR,VARIABLE, 5K	72P5KOHM	73138	1
A3A1R2	RESISTOR,COMPOSITION, 100K,5%,½W	RC20GF104J	81349	4
A3A1R3	RESISTOR,COMPOSITION, 1 MEG,5%,½W	RC20GF105J	81349	5
A3A1R4	NOT USED			
A3A1R5	NOT USED			
A3A1R6	SAME AS A3A1R2			
A3A1R7	SAME AS A3A1R3			
A3A1R8	RESISTOR,COMPOSITION, 1K, 5%, 2W	RC42GF102J	81349	3
A3A1R9	RESISTOR, WIREWOUND, 1K, 5%, 3W	23J1K0	44655	1
A3A1R10	NOT USED			
A3A1R11	RESISTOR,COMPOSITION, 470K, 5%, ½W	RC20GF474J	81349	1
A3A1R12	RESISTOR,COMPOSITION, 100K, 5%, 1W	RC32GF104J	81349	1
A3A1R13	SAME AS 1A3A1R8			
A3A1R14	SAME AS A3A1R3			
A3A1R15	NOT USED			
A3A1R16	NOT USED			
A3A1R17	RESISTOR, VARIABLE, 250K	72P254	73138	1
A3A1R18	RESISTOR,COMPOSITION,270K, 5%, ½W	RC20GF274J	81349	1
A3A1R19 THRU A3A1R22	NOT USED			
A3A1R23	RESISTOR,COMPOSITION, 10K, 5%, ½W	RC20GF103J	81349	2
A3A1R24	SAME AS A3A1R3			
A3A1R25	NOT USED			
A3A1R26	SAME AS A3A1R2			

TABLE 6-2 PARTS LIST

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	QTY
A3A1R27	NOT USED			
A3A1R28	SAME AS A3A1R3			
A3A1R29	RESISTOR, COMPOSITION, 220K, 5%, ½W	RC20GF224J	81349	1
A3A1R30	NOT USED			
A3A1R31	RESISTOR, VARIABLE, 5K, 5%, ½W	3339H-1-502	80294	1
A3A1R32	SAME AS A3A1R23			
A3A1R33	RESISTOR, COMPOSITION, 47K, 5%, 2W	RC42GF473J	81349	1
A3A1R34	RESISTOR, FILM, 10K, 1%, ½W	RN65C1002F	81349	1
A3A1R35	NOT USED			
A3A1R36	NOT USED			
A3A1R37	RESISTOR, FILM, 26.1K, 1%, ½W	RN65C2612F	81349	1
A3A1R38 THRU A3A1R40	NOT USED			
A3A1R41	RESISTOR, COMPOSITION, 620 OHMS,5%,½W	RC20GF621J	81349	1
A3A1R42	RESISTOR, VARIABLE, 200 K, 5%, ½W	3339-H-L-204	80294	1
A3A1R43	SAME AS A3A1R2			
A3A1R44	SAME AS A3A1R8			
A3A1R45	RESISTOR, COMPOSITION, 39K, 5%, ½W	RC20GF393J	81349	1
A3A1R46	RESISTOR, COMPOSITION, 100K, 5%, 2W	RC42GF104J	81349	1
A3A1R47 THRU A3A1R50	NOT USED			
A3A1R51	RESISTOR, COMPOSITION, 3.9 K, 5%, ½W	RC20GF392J	81349	1
A3A1R52	RESISTOR, COMPOSITION, 15K, 5%, ½W	RC20GF153J	81349	1
A3A1R53	RESISTOR, COMPOSITION, 2.7 MEG, 5%, 1W	RC32GF275J	81349	1
A3A1S1	SWITCH, PUSHBUTTON	A161316	82199	1
A3A1U1	INTEGRATED CIRCUIT	UA78-GUIC	13715	1
A3A1U2	INTEGRATED CIRCUIT	40014P	13715	1
A3A1U3	INTEGRATED CIRCUIT	CD4013AE	49671	1
A3A1U4	INTEGRATED CIRCUIT	SN72555P	01295	1
A3A2	**CAPACITOR BOARD ASSEMBLY**	**B161453-1**	**82199**	**1**
A3A2C1 THRU A3A2C5	NOT USED			
A3A2C6	CAPACITOR,ELECTROLYTIC,12UF,450VDCW	WBR12-1450	14655	4
A3A2C7	SAME AS A3A2C6			
A3A2C8	SAME AS A3A2C6			
A3A2C9 THRU A3A2C21	NOT USED			
A3A2C22	SAME AS A3A2C6			
A3A2C23 THRU A3A2C25	NOT USED			
A3A2C26	CAPACITOR, MYLAR, 0.1 UF, 1K VDCW	10PS-P10	56289	1
A3A2R1 THRU A3A2R18	NOT USED			
A3A2R19	RESISTOR, COMPOSITION, 270K, 5%, 1W	RC32GF274J	81349	4
A3A2R20	NOT USED			
A3A2R21	SAME AS A3A2R19			
A3A2R22	SAME AS A3A2R19			

TABLE 6-2 PARTS LIST

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	QTY
A3A2R23 THRU A3A2R35	NOT USED			
A3A2R36	RESISTOR, VARIABLE, 10K, 5%, 2W	70BIN048F103	01121	1
A3A2R37	NOT USED			
A3A2R38A/B	RESISTOR, VARIABLE, 25K, 5%, 2W	70DIN048P253W	01121	1
A3A3R39 THRU A3A2R46	NOT USED			
A3A2R47	SAME AS A3A2R19			
A3A3	**PUSHBUTTON BRACKET ASSEMBLY**	**B161495**	**82199**	**1**
A3A3R4	RESISTOR, VARIABLE, 100K, 5%, 2W	70BIN56P104W	01121	2
A3A3R16	SAME AS A3A3R4			
A4	**HIGH VOLTAGE CONTROL BOARD**	**C161321-1**	**82199**	**1**
A4BR1	BRIDGE RECTIFIER	MDA970-1	04713	1
A4C1	CAPACITOR, ELECTROLYTIC,5800 UF 40 VDCW	96F556M1	56289	1
A4C2	CAPACITOR, ELECTROLYTIC, 470 UF, 40 VDCW	503D-477GO	56289	2
A4C3	SAME AS A4C2			
A4C4	CAPACITOR, ELECTROLYTIC, 100 UF, 16 VDCW	503D-107GO	56289	1
A4C5	NOT USED			
A4C6	CAPACITOR, MYLAR, 0.1 UF	280AE/104	73445	1
A4C7	CAPACITOR, TANTALUM, 10 UF,10%,25VDCW	162D106X902DD2	56289	1
A4C8	CAPACITOR, ELECTROLYTIC,10UF, 25 VDCW	503D106G025AB	56289	1
A4C9	CAPACITOR,ELECTROLYTIC, 22UF, 25 VDCW	503D226G025AB	56289	1
A4C10	NOT USED			
A4C11	CAPACITOR, MICA, 200 UUF, 10%	CM05D200G03	81349	1
A4C12	SAME AS A4C11			
A4CR1	SEMICONDUCTOR DEVICE, DIODE	1N456	81349	3
A4CR2	SAME AS A4CR1			
A4CR3	SAME AS A$CR1			
A4CR4	SEMICONDUCTOR DEVICE, DIODE	IN4742A	81349	1
A4F1	FUSE, CARTRIDGE, 2.5 AMP	31202.5	75915	1
A4F2	FUSE,CARTRIDGE, ¼ AMP	312.250	75915	1
A4Q1	TRANSISTOR	2N4402	81349	1
A4Q2	TRANSISTOR	MJE3055T	04713	3
A4Q3	SAME AS A4Q2			
A4Q4	SAME AS A4Q2			
A4Q5	TRANSISTOR	2N5190	81349	1
A4R1	RESISTOR, FILM, 0.2 OHMS, 1%, 2W	AS-1-0.2,1%	75042	1
A4R2	RESISTOR, COMPOSITION, 15 OHMS, 5%, 1W	RC32GF150J	81349	1
A4R3	RESISTOR, COMPOSITION, 200 OHMS, 5%,½W	RC20GF201J	81349	1
A4R4	RESISTOR, VARIABLE, 500 OHMS	3339H-1-401	80294	1
A4R5	NOT USED			
A4R6	RESISTOR, COMPOSITION, 10K, 5%, ½W	RC20GF103J	81349	6
A4R7	RESISTOR, COMPOSITION, 1.2K, 5%, ½W	RC20GF122J	81349	1
A4R8	RESISTOR, WW, 180 OHMS, 5%, 5W	5XM180	63742	1
A4R9	RESISTOR, COMPOSITION, 1K, 5%, ½W	RC20GF102J	81349	5
A4R10	RESISTOR, COMPOSITION, 270 OHMS, 5%, ½W	RC20GF271J	81349	1
A4R11	SAME AS A4R6			
A4R12	SAME AS A4R6			

TABLE 6-2 PARTS LIST

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	QTY
A4R13	RESISTOR, COMPOSITION, 4.7 MEG, 5%, ½W	RC20GF475J	81349	1
A4R14	SAME AS A4R9			
A4R15	NOT USED			
A4R16	SAME AS A4R6			
A4R17	SAME AS A4R6			
A4R18	RESISTOR, FILM, 10K, 1%, ½W	RN65C1002F	81349	2
A4R19	SAME AS A4R18			
A4R20	SAME AS A4R9			
A4R21	RESISTOR, VARIABLE, 1K	3339H-1-102	80294	1
A4R22	RESISTOR, FILM, 5.62K, 1%, ½W	RN65C5621F	81349	1
A4R23	RESISTOR, COMPOSITION, 150 OHMS, 5%, ½W	RC20GF151J	81349	1
A4R24	SAME AS A4R6			
A4R25	SAME AS A4R9			
A4R26	NOT USED			
A4R27	NOT USED			
A4R28	RESISTOR, COMPOSITION, 2K, 5%,½W	RC20GF202J	81349	1
A4U1	INTEGRATED CIRCUIT	SN72555P	01295	1
A4U2	INTEGRATED CIRCUIT	MC78M20CP	04713	1
A4U3	INTEGRATED CIRCUIT	SN72723L	01295	1
A5	**HIGH VOLTAGE BOX**	**D161309-2**	**82199**	**1**
A5A1	**HV GENERATOR COMPONENT ASSY**	**A161443-1**	**82199**	**1**
A5A1BR1	RECTIFIER, BRIDGE	MDA920A-3	04713	1
A5A1C1	NOT USED			
A5A1C2	NOT USED			
A5A1C3	CAPACITOR, ELECTROLYTIC,12UF,450WVDC	WBR12-450	14655	8
A5A1C4 THRU A5A1C8	SAME AS A5A1C3			
A5A1C9	CAPACITOR, ELECTROLYTIC, 470 UF, 50 VDCW	503D477G0	56289	1
A5A1C10	NOT USED			
A5A1C11	NOT USED			
A5A1C12	CAPACITOR, ELECTROLYTIC, 100UF,16VDCW	503D-107G0	56289	1
A5A1C13	NOT USED			
A5A1C14	SAME AS A5A1C3			
A5A1C15	SAME AS A5A1C3			
A5A1CR1 THRU A5A1CR8	NOT USED			
A5A1CR9	SEMICONDUCTOR DEVICE, DIODE	SH30F	14099	4
A5A1CR10	SAME AS A5A1CR9			
A5A1CR11	SAME AS A5A1CR9			
A5A1CR12	SAME AS A5A1CR9			
A5A1R1	RESISTOR, COMPOSITION, 270K, 5%, 1W	RC32GF274J	81349	4
A5A1R2	SAME AS A5A1R1			
A5A1R3	SAME AS A5A1R1			
A5A1R4 THRU A5A1R7	NOT USED			
A5A1R8	RESISTOR, WW, 100 OHMS, 1%, 3W	300S,100 OHMS	83125	1
A5A1R9	NOT USED			
A5A1R10	SAME AS A5A1R1			

TABLE 6-2 PARTS LIST

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	QTY
A5A2	**MASTER OSCILLATOR COMPONENT ASSY**	**B161444-2**	**82199**	**1**
A5A2C1	CAPACITOR, ELECTROLYTIC, 470 UUF, 50 VDCW	503D-477G0	56289	2
A5A2C2	CAPACITOR, ELECTROLYTIC, 0.1 UF. 1KV	10PS-P10	56289	1
A5A2C3 THRU A5A2C9	NOT USED			
A5A2C10	SAME AS A5A2C1			
A5A2C11	CAPACITOR, ELECTROLYTIC, 0.05 UF, 1.6KV	16PS-S50	56289	1
A5A2CR1	SEMICONDUCTOR DEVICE, DIODE	1N4751A	81349	5
A5A2CR2	SAME AS A5A2CR1			
A5A2CR3	SAME AS A5A2CR1			
A5A2CR4	SAME AS A5A2CR1			
A5A2CR5	SEMICONDUCTOR DEVICE, DIODE	SH30F	14099	4
A5A2CR6	SAME AS A5A2CR5			
A5A2CR7	SAME AS A5A2CR5			
A5A2CR8	SAME AS A5A2CR5			
A5A2CR9 THRU A5A2CR12	NOT USED			
A5A2CR13	SEMICONDUCTOR DEVICE, DIODE	1N456	81349	3
A5A2CR14	SAME AS A5A2CR13			
A5A2CR15	SAME AS A5A2CR1			
A5A2CR16	SAME AS A5A2CR13			
A5A2R1	NOT USED			
A5A2R2	NOT USED			
A5A2R3	NOT USED			
A5A2R4	RESISTOR, COMPOSITION,470 OHMS,5%,½W	RC20GF471J	81349	1
A5A2R5	RESISTOR, VARIABLE, 20K	3339W-1-203	80294	1
A5A2R6	RESISTOR, WW, 470 OHMS, 5%, 3W	VC3D,470,5%	12697	1
A5A2R7	RESISTOR, FILM, 1 MEG, 1%, 2W	CGH-2, 1 MEG	75042	1
A5A2T1	TRANSFORMER	B161314	82199	1
A5A2U1	INTERGRATED CIRCUIT	SN72741L	01295	1
A5Q1	TRANSISTOR	2N5988	81349	2
A5Q2	SAME AS A5Q1			
A5T2	TRANSFORMER	C161313	82199	1
A5W11	CABLE ASSEMBLY	B161490	82199	1
A5W12	CABLE ASSEMBLY	B161491	82199	1
A6	**TRACKING BOARD ASSY (1107E,1207E)**	**B161330-1**	**82199**	**1**
A6J1	CONNECTOR, PLUG	350792-1 (RED)	00779	1
A6J2	CONNECTOR, PLUG	350432-1 (WHITE)	00779	1
A6R1	RESISTOR, VARIABLE, 50K, 5%, 2W	70B5L040S503W	01121	1
A6R2	RESISTOR, VARIABLE, 25K, 5%, 2W	70B5L040S253W	01121	1
A6R3	RESISTOR, VARIABLE, 250K, 5%,2W	70B5L040S254W	01121	2
A6R4	RESISTOR, VARIABLE, 100K, 5%,2W	70B5L040S104W	01121	2
A6R5	SAME AS A6R3			
A6R6	SAME AS A6R4			

TABLE 6-2 PARTS LIST

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S CODE	QTY
A6	**TRACKING BOARD ASSY(1108E,1208E)**	**C167156**	**82199**	**1**
A6J1	CONNECTOR, PLUG	350792-1 (RED)	00779	1
A6J2	CONNECTOR, PLUG	350432-1 (WHITE)	00779	1
A6R1	RESISTOR, VARIABLE, 100K,5%, 2W	70B5L040S104W	01121	3
A6R2	SAME AS A6R1			
A6R3	RESISTOR, VARIABLE, 250K, 5%, 2W	70B5L040S254W	01121	1
A6R4	SAME AS A6R1			
A6R5	RESISTOR, COMPOSITION, 18K, 5%, ½W	RC20GF183J	81349	1
A7	**TUNING HEAD ASSY (1107E)**	**E161550**	**82199**	**1**
A7	**TUNING HEAD ASSY (1108E)**	**E149002**	**82199**	**1**
A7	**TUNING HEAD ASSY (1207E)**	**C161714**	**82199**	**1**
A7	**TUNING HEAD ASSY (1208E)**	**E149050**	**82199**	**1**
A7R1	RESISTOR, VARIABLE, 100K, 1%, 9W	005033	82199	1
A7S1	SWITCH, SENSITIVE	AN4234-1	81349	1
A7S2	SAME AS A7S1 (1107E,1207E)			
A8	**METER ASSY**	**B161311**	**82199**	**1**
A8M1	METER	A710282	82199	1
B1	FAN	WS2107FL	92702	1
C1	CAPACITOR, CERAMIC, 0.0047 UF	60GAD47	56289	1
DS1	LAMP	1050C3	56289	1
J1	CONNECTOR, RECEPTACLE	B161509	82199	3
J2	SAME AS J1			
J3	SAME AS J1			
V1	KLYSTRON (1107E, 1207E)	A160011A	82199	1
V1	KLYSTRON (1108E)	A160034	82199	1
V1	KLYSTRON (1208E)	A160035	82199	1
W1	CABLE ASSEMBLY	B161507	82199	1
W7	KLYSTRON COVER ASSY	B161779	82199	1
W8	CABLE ASSEMBLY (1107E,1108E)	B161503	82199	1
W9	CABLE ASSEMBLY (1107E,1108E)	B160851	82199	1
W10	TERMINAL BOARD CABLE ASSY	B161497-1	82199	1
W13	CABLE ASSEMBLY	B161504	82199	1
W14	CABLE ASSY(POWER SET PROBE)	A149252	82199	1
W15	CABLE ASSY(ATTENATOR PROBE) (1107E, 1108E)	C160850	82199	1
W15	CABLE ASSY)(ATTENUATOR PROBE) (1207E, 1208E)	C149250	82199	1
W16	CABLE ASSEMBLY	B161505	82199	1
Z1	DETECTOR	A160359	82199	1

POLARAD ELECTRONICS,INC.
5 Delaware Drive Lake Success,New York 11042 516-328-1100

REQUEST FOR MAINTENANCE

FROM:

COMPANY NAME _____ DATE: _____

ADDRESS: _____ INDIVIDUAL: _____

_____ POSITION: _____

_____ PHONE NO. _____ EXT. _____

_____

SECTION OR DIVISION: _____

EQUIPMENT: _____ DATE OF PURCHASE: _____

MODEL _____ SERIAL NO. _____ ORDER NO. _____

_____

TROUBLE REPORT:

A. Description of trouble _____

_____

_____

_____

_____

_____

B. Has trouble been localized? _____ If so, how and where: _____

_____

_____

_____

_____

_____

C. Instruments used and measurements taken, if any: _____

_____

_____

_____

_____

D. Is trouble intermittent? _____

E. Hours of operation prior to this trouble _____

F. Date troubled occurred _____

G. Was factory consulted by telephone or letter prior to this request? _____

If so, give date and person to whom directed: _____

_____

H. Additional comments: _____

_____

_____

_____

_____

_____

_____

_____

When trouble develops requiring factory assistance, complete this form and send to:

Polarad Electronics, Inc.
5 Delaware Drive
Lake Success, New York 11042
Attn: Service Department

After this report has been analyzed by the Service Department, you will be notified when a field service engineer will call on you to make the necessary repairs. If your trouble can best be corrected at the factory, we will notify you with instructions and authorization for returning the equipment.

NO EQUIPMENT MAY BE RETURNED TO THE FACTORY WITHOUT WRITTEN AUTHORIZATION

INSTRUCTION MANUAL

MODULATOR
MODEL 1020A

d polarad polarad **polarad** po

Polarad Electronics, Inc. 5 Delaware Dr. Lake Success N.Y. 11042 Tel: 516-328-1100 TWX: 510-223-0414

OCTOBER 1980

Instrumentation

Warranty

polarad electronics, inc.

We warrant each new instrument to be free of defects in materials and workmanship.

We will service, repair and adjust as required any instrument which proves defective within one year after date of delivery and which is returned to our factory (or other authorized depot) for that purpose.

For warranty information or other assistance, please contact Polarad Customer Service Department in Lake Success, New York, or an authorized regional service depot.

No other warranty is expressed or implied. No liability is assumed for consequential damages.

5 Delaware Drive
Lake Success, New York 11042
516-328-1100
TWX: 510-223-0414

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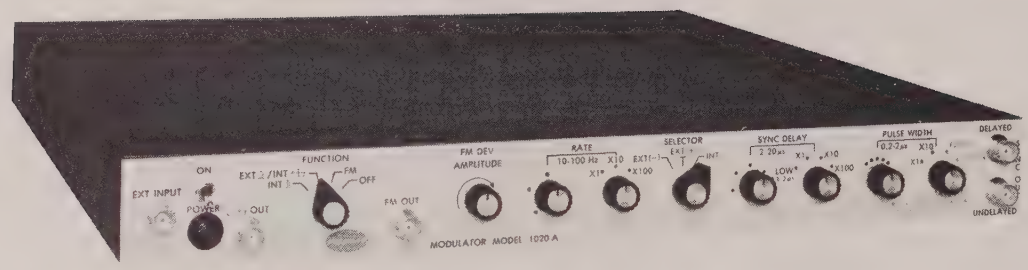


Figure 1-1. Model 1020A Modulator

SECTION I

INTRODUCTION

1-1. SCOPE OF MANUAL.

1-2. This manual contains instructions for the use and maintenance of the Model 1020A Modulator (figure 1-1), manufactured by Polarad Electronic Instrument Division of Polarad Electronics Corporation, Lake Success, New York. The manual includes a general description of the equipment, operating instructions, theory of operation, maintenance data, and a parts list.

1-3. PURPOSE AND USE OF THE EQUIPMENT.

1-4. Model 1020A Modulator is used for the modulation of signal generators, signal sources and oscillators. It is used in the testing of microwave radars, beacons and communication systems.

1-5. Model 1020A is capable of modulating Polarad Series 1100 Microwave Signal Generators and Series 1200 Microwave Signal Sources. It can be used with most commercially available signal generators.

1-6. GENERAL DESCRIPTION.

1-7. The Polarad Model 1020A Modulator is a function generator which provides adjustable well-defined precise pulses, square waves, and sawtooth waveforms. It is a valuable accessory for the 0.80-21 GHz Series 1100 Signal Generators and Series 1200 Signal Sources. It can also be used with many other instruments. The repetition rates of all output waveforms are variable from 10 to 10,000 Hz. Pulse outputs are from 0.2 to 2000 microseconds. The linear sawtooth output is adjustable in amplitude to vary FM deviation. The 1020A Modulator can be synchronized internally, or externally by positive pulses, negative pulses, or sine waves. Sharp 25 volt sync pulses are also generated. Sync outputs are undelayed and delayed from .3 to 2,000 microseconds. The compact Polarad Model 1020A Modulator is provided in a 1-3/4" high modular cabinet which permits convenient rack mounting or stacking with other modular units of this series of Polarad instruments. Four side mounting brackets are supplied for rigid attachment to any companion Polarad instruments. When the top cover is removed all parts are available for accessibility and ease of servicing.

1-8. EQUIPMENT SUPPLIED.

1-9. Table 1-1 lists the equipment supplied with the Model 1020A Modulator.

TABLE 1-1. EQUIPMENT SUPPLIED

NAME	POLARAD PART NO.
Microwave Modulator	Model 1020A
Rack Mount	A165931-1
Rack Mount	A165931-2
Video Cable (2 supplied)	C147363
Power Cable	B160833

1-10. EQUIPMENT SPECIFICATIONS.

1-11. Table 1-2 lists the equipment specifications for the Model 1020A.

TABLE 1-2. EQUIPMENT SPECIFICATIONS

CHARACTERISTIC	SPECIFICATION
Output Waveforms	Pulse, sawtooth and square wave
Internal Modulation:	
a. Square Wave Frequency	10 to 10,000 Hz, continuously adjustable
b. Pulse Repetition Rate	10 to 10,000 pps, continuously adjustable
Pulse Width	0.2 to 2000 microseconds, continuously adjustable
Synchronization	Internal or external
c. FM Type	Sawtooth
Frequency	10 to 10,000 Hz, continuously adjustable
Synchronization	Internal or external
External Modulation:	
Repetition Rate	Single pulse to 1 MHz
Pulse Width	0.5 to 2500 microseconds
Polarity	Positive or negative
Amplitude	5 to 50 volts peak
Synchronization:	
a. Internally Generated Outputs Type	Delayed and undelayed (separate outputs)

Continued on page 1-2.

TABLE 1-2. EQUIPMENT SPECIFICATIONS (Cont'd)

CHARACTERISTIC	SPECIFICATION
a. Internal Generated Outputs (cont'd)	
Repetition Rate	10 to 10, 000 pps
Polarity	Positive
Amplitude	25 volts peak, minimum into 1K ohm load
Delay	0.3 to 2000 microseconds continuously adjustable
b. External Sinewave Input	
Frequency	10 to 10, 000 Hz
Amplitude	5 to 70 volts rms
c. External Pulse Input	
Repetition Rate	Single pulse to 10, 000 pps
Amplitude	5 to 50 volts peak
Polarity	Positive or negative
Pulse Width	0.5 to 5 microseconds
Rise Time	0.1 to 1 microsecond
Weight	5 pounds
Size	1-3/4" H x 16-3/4" W x 16-3/8" D
Power Requirements	115 or 230 volts ±10%, 50 to 60 Hz single phase, 15 watts

SECTION II

OPERATION

2-1. GENERAL.

2-2. The Model 1020A is shipped complete and ready to operate; no special or permanent installation procedures are required. The instrument should be unpacked upon receipt, observing the usual precautions customary when unpacking an electronic instrument.

2-3. INSTALLATION.

2-4. After unpacking the instrument, plan its installation. The Model 1020A is supplied mounted in a cabinet for either bench or cart use or may be rack-mounted as shown in figure 2-2. The instrument requires 115 or 230 volts, single phase, 50 to 60 Hz ac power.

NOTE

The Model 1020A is shipped ready for 115-volt operation. If the instrument is to be operated from a 230-volt source, set the 115/230 volt SELECTOR switch, located at the rear of the unit, to the 230-volt position. The location of the switch is shown in figure 2-1.

2-5. Connect power cable B160833 between the AC INPUT connector and an ac power source receptacle. If the ac power source receptacle is not a grounding type, an adapter will be required.

2-6. OPERATING PROCEDURES.

2-7. The operating procedures for the Model 1020A are described in paragraphs 2-8 through 2-15.

2-8. OPERATING CONTROLS, INDICATORS, AND CONNECTORS. The operating controls, indicators, and connectors of the instrument are shown in figure 2-1. Their functions are listed in table 2-1.

2-9. CONNECTIONS AND PRELIMINARY OPERATION. To operate the Model 1020A, proceed as follows:

a. Connect instrument to signal source or generator and device under test as shown in figure 2-3.

b. Set POWER switches to ON and allow the instruments to warm up for 15 minutes.

2-10. FM OPERATION – INTERNAL SYNCHRONIZATION. Connect FM OUT jack of the Model 1020A to the instrument being modulated and proceed as follows:

a. Couple DELAYED SYNC OUT connector and/or UNDELAYED SYNC OUT connector, as required, to the instrument being tested or to monitoring equipment.

b. Set SYNC SELECTOR switch to INT.

c. Set the FUNCTION selector switch to its FM position.

d. Adjust RATE control and X1-X10-X100 multiplier switch to obtain the desired repetition rate which may be varied from 10 to 10, 000 pps.

e. Adjust FM DEV AMPLITUDE control to obtain desired frequency excursion of the modulated signal.

2-11. FM OPERATION – EXTERNAL SYNCHRONIZATION. Model 1020A may be synchronized by externally applied positive or negative pulses or sine waves with an amplitude of 5 to 50 volts peak for the pulses or 5 to 50 volts rms for the sine waves. The same operational procedure is followed as for internally synchronized FM operation except that the selector switch is placed in EXT(+) or EXT(-) position as determined by the nature of the externally-supplied synchronizing signal. The RATE control and X1-X10- X100 multiplier switch must be set so that the free running sawtooth rate is lower than the externally supplied synchronizing signal in order for synchronization to be effective.

2-12. INTERNALLY SYNCHRONIZED SQUARE-WAVE OPERATION. To obtain a square-wave modulated output from the instrument being modulated, proceed as follows:

a. Couple DELAYED SYNC OUT connector and/or UNDELAYED SYNC OUT connector, as required, to the instrument being tested or to monitoring equipment.

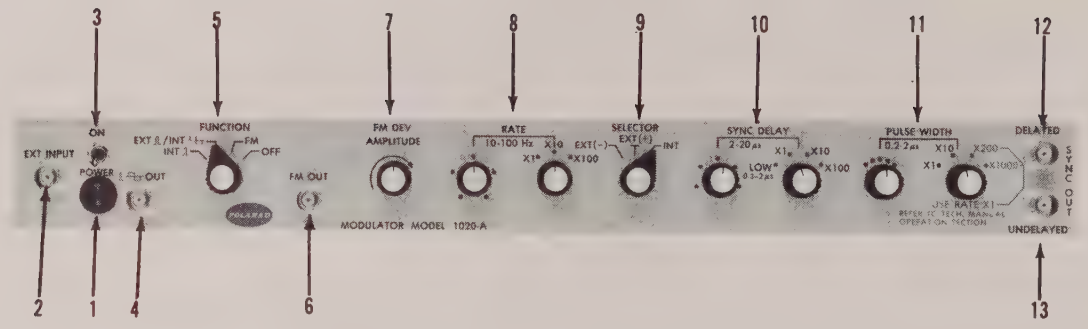
b. Connect ⎍ ⊓ OUT jack of the Model 1020A to the instrument being modulated.

c. Set the FUNCTION selector switch to its EXT⎍/INT⊓ position.

d. Set the SELECTOR switch to INT.

e. Adjust RATE control and X1-X10-X100 multiplier switch to obtain the desired repetition rate.

f. DUTY CYCLE – DELAY LIMITATIONS. Figure 2-4 includes the pulse width to 2000 μsec. The regions for stable operation are below the curves.

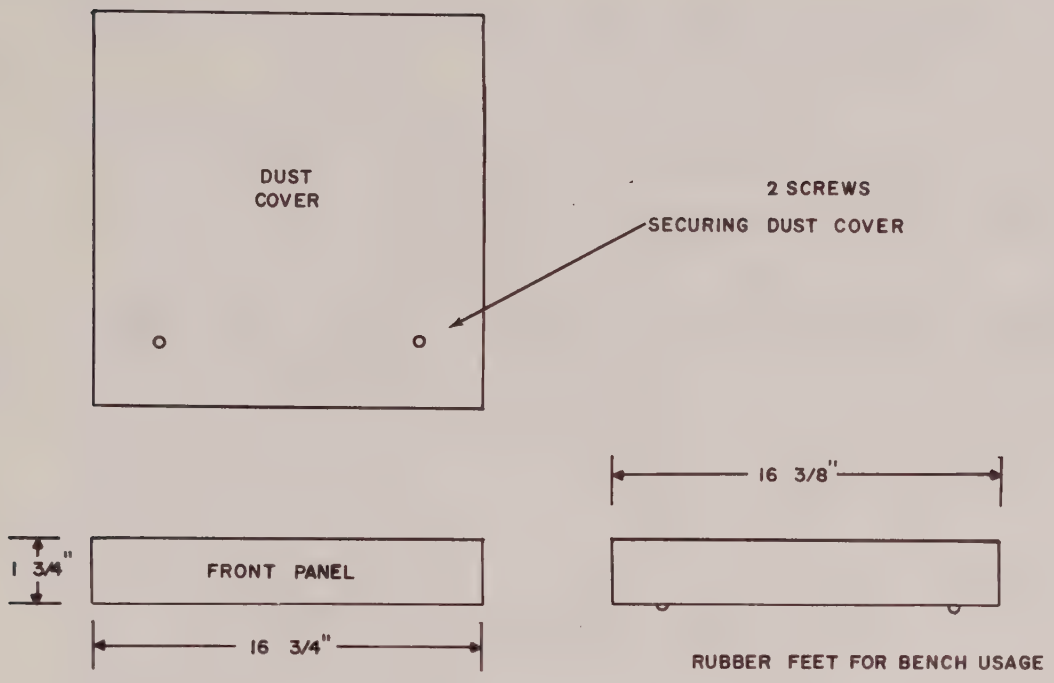


FRONT PANEL CONTROLS, INDICATORS AND CONNECTORS
(See Table 2-1)

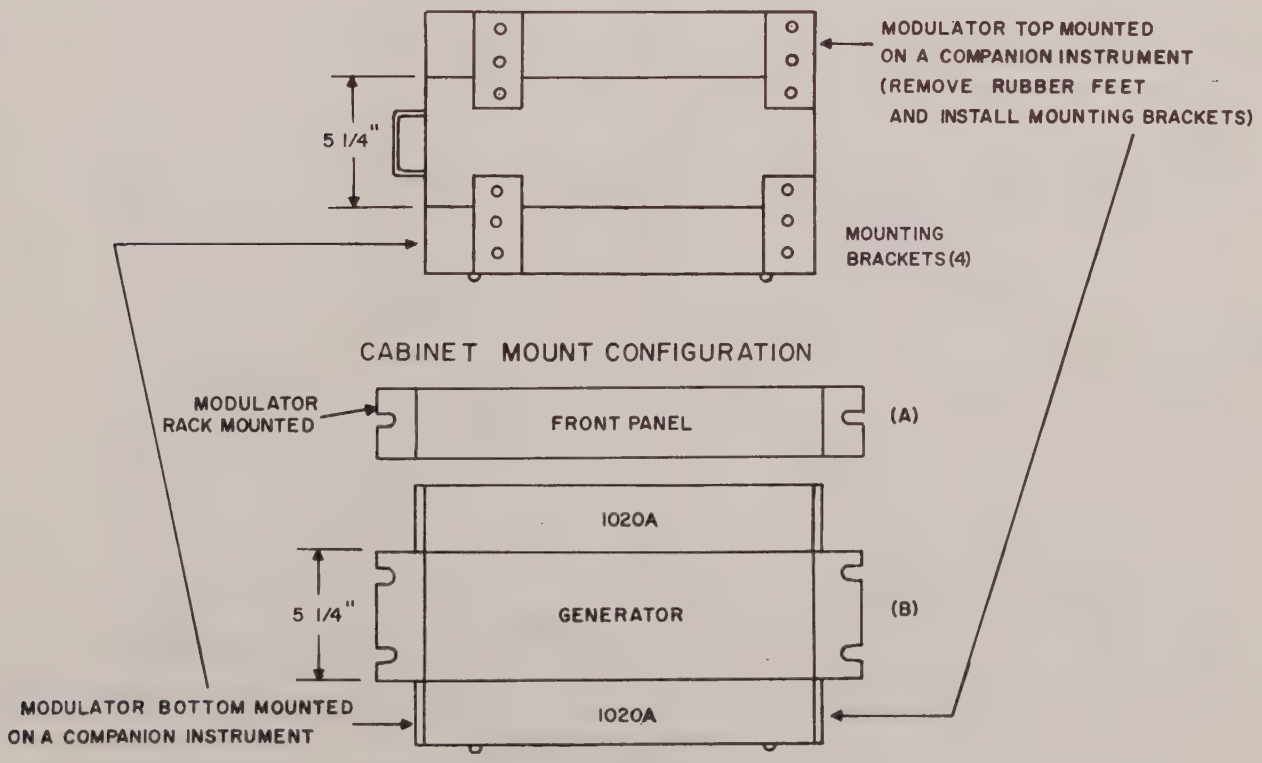
REAR PANEL CONTROLS

(See Table 2-1)

Figure 2-1. Model 1020A Operating Controls, Indicators and Connectors



MODULATOR MODEL 1020A OUTLINE DIMENSIONS



RACK MOUNT CONFIGURATION

Figure 2-2. Installation Outline Drawings, Model 1020A Modulator

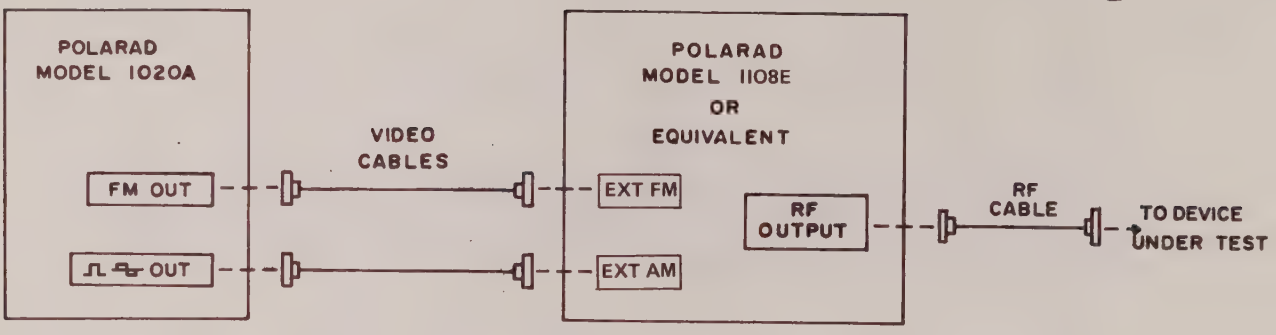


Figure 2-3. Operational Setup for the Model 1020A

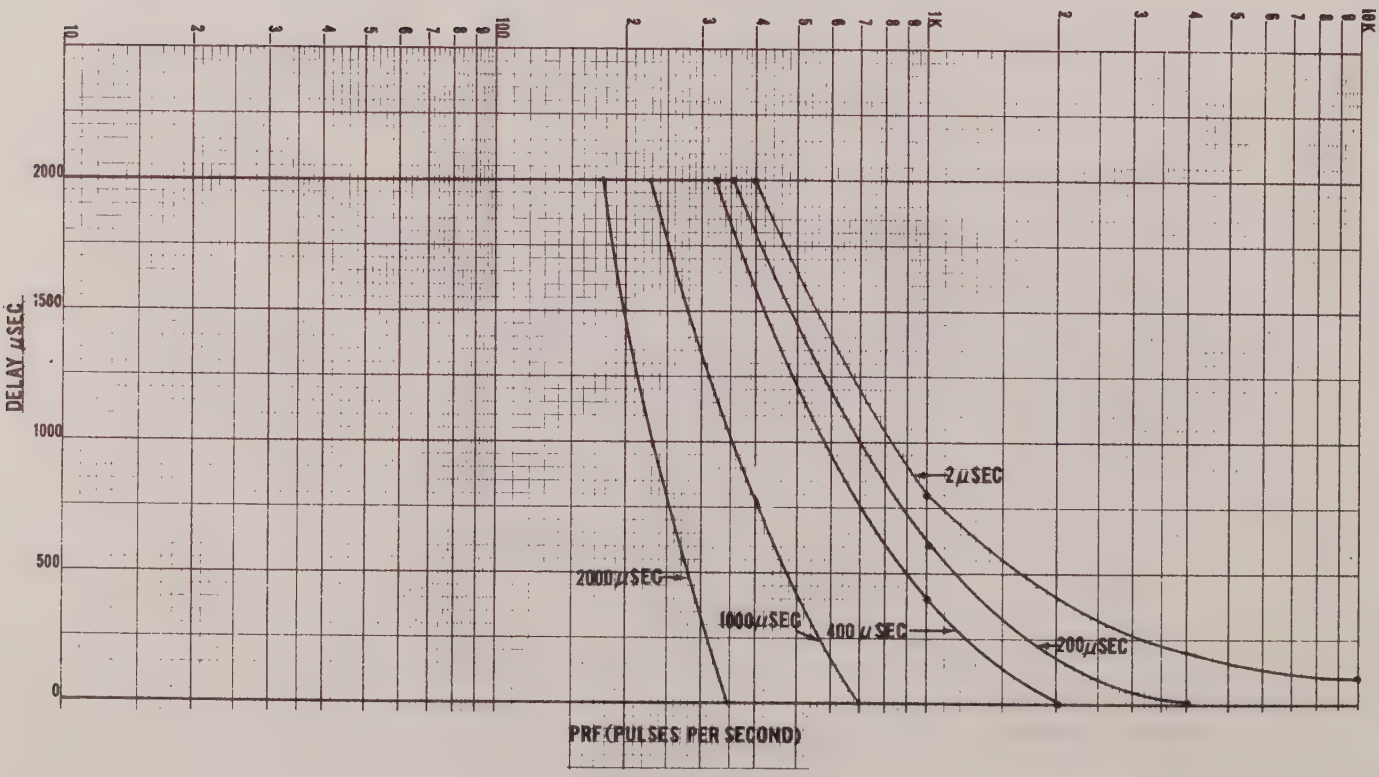


Figure 2-4. Maximum Pulse Delay Versus Repetition Rate

TABLE 2-1. OPERATING CONTROLS, INDICATORS, AND CONNECTORS

Figure 2-1 Index No.	Control, Indicator, or Connector	Function
1	ON indicator lamp	Lights when power is applied to instrument.
2	EXT INPUT connector	Connects the Model 1020A to either externally synchronizing or externally pulse modulating signals.
3	POWER switch	Controls application of ac power.
4	⎍⎍ OUT connector	Couples output pulse or output square wave waveforms to EXT PULSE input jack on signal generator.
5	FUNCTION switch	Selects internal pulse, internal square wave, FM, external pulse modulation, or no modulation.
6	FM OUT connector	Couples output sawtooth waveform to EXT FM input jack on signal generator.
7	FM DEV AMPLITUDE control	Adjusts amplitude of output sawtooth. (Adjusts deviation about center frequency of rf output when MODULATION SELECTOR switch on signal source is set to EXT FM position.)
8	RATE control and X1-X10-X100 multiplier switch	Adjusts modulation repetition rate from 10 to 10, 000 pps.
9	SELECTOR switch	Enables Modulating Output signals to be either internally or externally controlled as follows: a. Must be set to EXT(+) when a positive synchronizing pulse or a positive modulating pulse is externally applied. b. Must be set to EXT(-) when a negative synchronizing pulse or a negative modulating pulse is externally applied. c. May be set to EXT(+) or EXT( ) when a sine wave synchronizing signal is externally applied. d. Must be set to INT when no external synchronizing signal is applied.
10	SYNC DELAY control and LOW-X1-X10-X100 multiplier switch	Adjusts delay between both rf output pulse and delayed sync output pulse from 0.3 to 2000 microseconds.
11	PULSE WIDTH control and X1-X10-X200-X1000 multiplier switch	Adjusts width of rf output pulse from 0.2 to 2000 μsec. X1 0.2 to 2 μsec X200 40 to 400 μsec X10 2.0 to 20 μsec X1000 200 to 2000 μsec Pulse width range overlap on the X10 and X200 multiplier positions provides pulse width from 20 μsec to 40 μsec.
12	DELAYED SYNC OUT connector	Provides positive video trigger pulse in time coincidence with leading edge of rf output pulse.
13	UNDELAYED SYNC OUT	Provides positive video trigger pulse which leads both rf output pulse and delayed sync output pulse in time.
14	115/230 SELECTOR switch*	Selects input power voltage level.
15	AC INPUT connector*	Connection for external ac power source.
16	AC OUTPUT connector*	Connection for ac power cable between Model 1020A and other equipment.
17	Fuse .25 AMP*	Circuit protection

* Rear Panel

For example, at 2.0 μsec width and pulse repetition rate of 1000 Hz, the maximum stable delay would be 800 μsec. The graph in figure 2-4 is based on the following equation:

$$\text{DELAY} = \left(\frac{(0.7)\ 10^6}{\text{PRF}} - \text{PULSE WIDTH} \right) \quad (1)$$

Where Delay is in μsec, width is in μsec, and PRF is in pulses/sec.

g. The front panel of the Model 1020A has a caution notice to the use of the RATE X1 multiplier when in the X200 and X1000 PULSE WIDTH position. The caution notice is to provide a guideline for stable pulsing at any selected pulse width and delay combination. Other stable combinations of width, rate, and delay are available. These are the parameters falling below the graph line in figure 2-4. To illustrate, if the pulse width is 400 μsec and the delay 200 μsec, stable operation can be maintained up to 1166 pps, as shown in figure 2-4.

h. The STABILITY SAFETY formula contains a 70% safety factor. Any combination of Delay, Width, and PRF that satisfy this formula will result in stable pulsing. Stable operation may be maintained in most control combinations up to the instrument's pulsing capability, without the safety factor. This can be derived by dropping the 0.7 multiplier in Equation No. 1, resulting in the equation:

$$\text{DELAY} = \frac{10^6}{\text{PRF}} - \text{PULSE WIDTH} \quad (2)$$

If the controls are set beyond limits of the curve, figure 2-4 (Operations Settings above the curves), use of an external scope is recommended to be sure of stable operation. There cannot be stable pulsing beyond the limits of Equation No. 2.

NOTE

Do not exceed duty cycle. Refer to figure 2-4.

2-13. INTERNALLY SYNCHRONIZED PULSE OPERATION. To obtain a pulse-modulated output from the instrument being modulated, proceed as follows:

a. Couple DELAYED SYNC OUT connector and/or UNDELAYED SYNC OUT connector, as required, to the instrument being tested or to monitoring equipment.

b. Connect ⎍ ⊓ OUT jack of the Model 1020A to the instrument being modulated.

c. Set the FUNCTION selector switch to its INT position.

d. Set SELECTOR switch to INT.

e. Adjust RATE control and X1-X10-X100 multiplier switch to obtain desired pulse repetition rate.

f. Adjust PULSE WIDTH control to obtain desired pulse width.

g. Adjust SYNC DELAY control and X1-X10-X100 multiplier switch to obtain desired delay between the undelayed sync output pulse and both the delayed sync output pulse and the leading edge of the pulse-modulated rf output signal.

NOTE

Do not exceed duty cycle. Refer to figure 2-4.

2-14. EXTERNALLY SYNCHRONIZED PULSE OPERATION. The Model 1020A may be synchronized by externally applied positive or negative pulses or sine waves with an amplitude of 5 to 50 volts peak for the pulses or 5 to 50 volts rms for the sine waves. The same operational procedure is followed as for internally synchronized pulse operation (paragraph 2-13) except that SELECTOR switch is placed in either EXT(-) or EXT(+) position, as determined by the nature of the externally supplied synchronizing signal.

NOTE

Do not exceed duty cycle. Refer to figure 2-4.

2-15. EXTERNAL PULSE OPERATION. To obtain a pulse-modulated output from the instrument being modulated, programmed by an external pulse source, proceed as follows:

a. Couple DELAYED SYNC OUT connector and/or UNDELAYED SYNC OUT connector, as required to the equipment being tested or to monitoring equipment.

b. Connect ⎍ ⊓ OUT jack of the Model 1020A to the instrument being modulated.

c. Set the FUNCTION switch to its EXT ⎍ / INT ⊓ position.

d. Set SELECTOR switch to EXT(+) or EXT(-).

e. The pulse width and repetition rate are both a function of the settings on the external pulse source.

NOTE

Do not exceed duty cycle. Refer to figure 2-4.

2-16. PACKAGING INSTRUCTIONS.

2-17. PACKAGING FOR SHORT-TERM STORAGE. If the Model 1020A is to be stored for a relatively short period, cover it with a suitable protective covering such as a sheet of plastic or paper. Put the accessories and instruction manual in a carton or bag and fasten it to the unit to prevent loss. Store the Model 1020A in a clean dry area where it will not be subject to extreme temperatures.

2-18. PACKAGING FOR LONG-TERM STORAGE OR SHIPMENT. If the Model 1020A is to be stored for a long period of time, or shipped, proceed as follows:

a. If the original wrappings and carton have been saved, use them to package the equipment as shown in figure 2-5.

b. If new packing materials are to be used, assemble the necessary wrappings and carton.

c. Wrap the equipment in a moisture- and vapor-proof barrier such as plastic or water proof paper.

d. Wrap the accessories and instruction manual in a moisture- and vapor-proof barrier.

e. Place the package in a suitable carton. Fill all empty spaces in the carton with suitable packing to prevent shifting of the packages within the carton.

f. Seal and mark the carton.

g. If the storage or shipping conditions make it necessary, enclose the carton within an outer carton or wooden box.

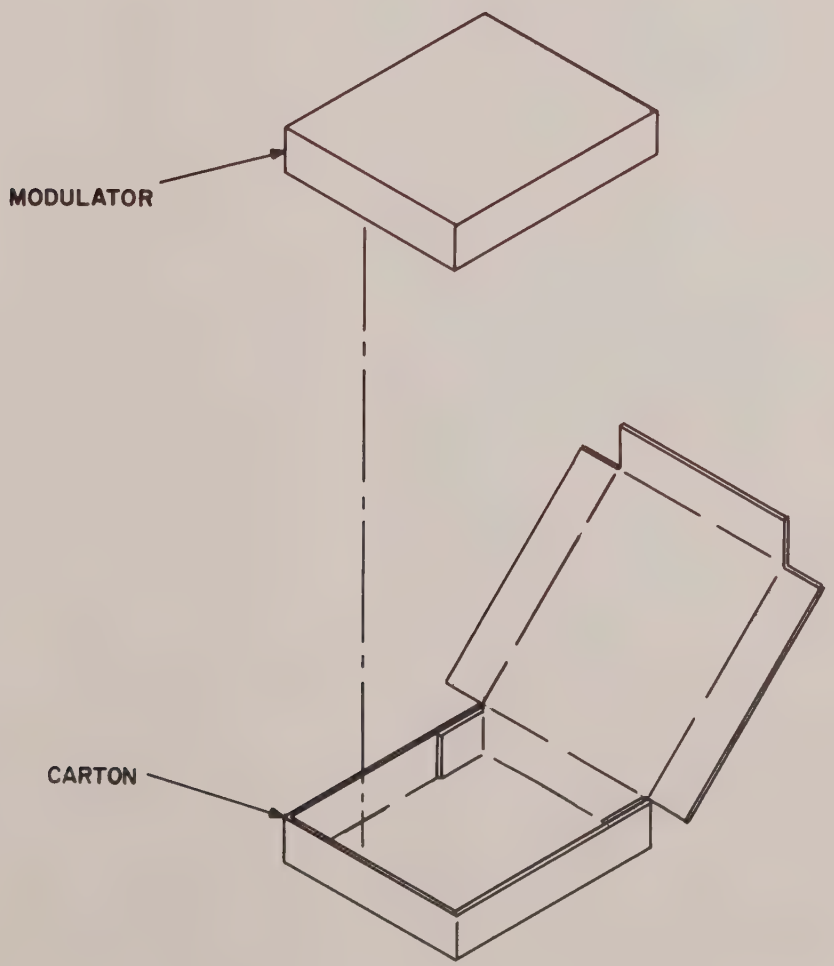


Figure 2-5. Packaging Diagram, Model 1020A

SECTION III

THEORY OF OPERATION

3-1. GENERAL.

3-2. The Model 1020A Modulator is a precision pulse, square-wave, sawtooth generator designed for use with the Polarad Series 1100 Signal Generators, Polarad Series 1200 Signal Sources, and most other available commercial signal generators and sources.

3-3. BLOCK DIAGRAM ANALYSIS. (Figure 3-1)

3-4. The Model 1020A is comprised of a group of circuits which generate, shape and delay the various waveforms as required. The Rate Generator is a free-running unijunction oscillator which serves to generate the basic pulse repetition rates. This circuit is also the source of the sawtooth for FM operation. When the FUNCTION switch, S2, is set at its INT⎍ position and the SELECTOR switch, S3, is set at its INT position, the pulse output of the Rate Generator, divided by two by means of the ÷ 2 Flip/Flop, is applied to the Schmitt Trigger. The Schmitt Trigger output, a square wave, is applied to the Pulse Generator where the output pulses of desired width and delay are generated. The Pulse Generator consists of two integrated circuit monostable multivibrators IC1 and IC2. IC1 develops the desired pulse delay of 2 to 2000 usec in conjunction with front panel controls DELAY uSEC, R41, and LOW-X1-X10-X100 multiplier switch, S4. IC1 has two outputs; one output is applied to the Undelayed Sync Amp for amplitude and impedance conditioning prior to appearing at the UNDELAYED SYNC OUT output connector J3. The other output is applied to IC2 where the desired output pulse width of 0.2 to 2000 usec is developed in conjunction with PULSE WIDTH control, R76 and X1-X10-X200-X1000 switch, S7. IC2 also has two outputs; one output is applied to the Delayed Sync Amp for amplitude and impedance conditioning prior to appearing at the DELAYED SYNC OUT connector J2. The other output is routed through the FUNCTION switch to the ⎍ ⊓ Output Amplifier prior to appearing at the OUT output connector J5. With the FUNCTION switch set at its EXT⎍ /INT⊓ position and the SELECTOR switch set at INT, the square wave output of the Schmitt Trigger is applied to the ⎍ ⊓ Output Amplifier rather than the output of IC1 and the resultant output at the⎍ ⊓ OUT output connector is a square wave. With the FUNCTION switch set at its EXT⎍ /INT⊓ position and the SELECTOR switch set at its EXT (-) or EXT (+) position, an external signal connected to the EXT INPUT connector, J1, is processed through the EXT Signal Amplifier to the Schmitt Trigger input. The output signals appearing at the ⎍ ⊓ OUT, UNDELAYED SYNC OUT, and DELAYED SYNC OUT connectors J5, J3 and J2 respectively are directly related to the external input signal applied to the EXT INPUT connector J1. With the FUNCTION switch set at its FM position and the Selector Switch set at INT, the sawtooth output of the Rate Generator is processed through the Sawtooth Amplifier. The output of the Sawtooth Amplifier is applied across FM AMPLITUDE control R21. The wiper of the FM AMPLITUDE control is the output sawtooth and is connected to the FM OUT output connector, J4. With the function switch set at FM and the selector switch set at EXT (+), the rate of the Rate Generator will be synchronized with the rate of the externally applied synchronizing signal provided that the RATE control and X1, X10, X100 switches are set to a rate lower than the incoming synchronizing rate.

3-5. DETAILED CIRCUIT ANALYSIS. (Figure 5-1)

3-6. Paragraphs 3-7 through 3-17 contain a detailed analysis of the various circuits of the Model 1020A.

3-7. RATE GENERATOR Q1, Q23. The rate generator is a free-running unijunction oscillator. With the FUNCTION switch in its INT⎍ or EXT⎍ /INT⊓ position and the RATE X1-X10-X100 switch set at its X100 position the basic repetition rate is determined by RC components R4, R5, R6, and C3 and will be in the range of 2,000 to 20,000 pps. The actual rate will depend upon the setting of front panel RATE control R5. When the RATE X1-X10-X100 switch is placed in its X1 position the repetition rate will be in the range of 20-200 pps due to the addition of C1 which increases the charging time constant in the unijunction emitter circuit. Q23 is a feedback current source which linearizes the sweep. As the capacitive components charge in the emitter circuit a positive going sawtooth waveform is developed. When the firing potential is reached at the emitter, Q1 turns on and allows the capacitive components to discharge through R2 and L1 creating sharp positive pulses across R2 and L1. These pulses are fed to the ÷2Flip/Flop which divides the input pulses in half to develop the output repetition rates of 10 to 10,000 pps.

3-8. When the FUNCTION switch is placed in its FM position additional capacitive components are added to the emitter charging circuit. The components are C7, C8 and C9, in the RATE X1-X10-X100 positions respectively. No division takes place in this mode of operation and the rates developed are the output rates. The sawtooth waveform developed in the Q1 emitter circuit is fed to the Sawtooth Amplifier for further processing. R6 in the Q1 emitter circuit is adjusted in conjunction with R5 to provide the high repetition rate which is approximately 10,000 pps. The adjustment of R6 is described in paragraph 4-13. When the selector switch is placed in the external positions, an external positive signal (selector set to EXT (+), an external negative signal (selector set to EXT (-), or a sinewave may be used to synchronize the sawtooth waveform. This is performed by transistor Q22. Q22 is turned on by the undelayed signal pulse. This causes the unijunction transistor Q1 to fire.

3-9. ÷ 2 FLIP/FLOP Q2, Q3. The ÷ 2 Flip/Flop accepts the positive going pulses from the Rate Generator, in the range of 20-20,000 pps, and produces a square wave at the collector of Q3, at the output rate of 10-10,000 Hz. The square wave is routed through

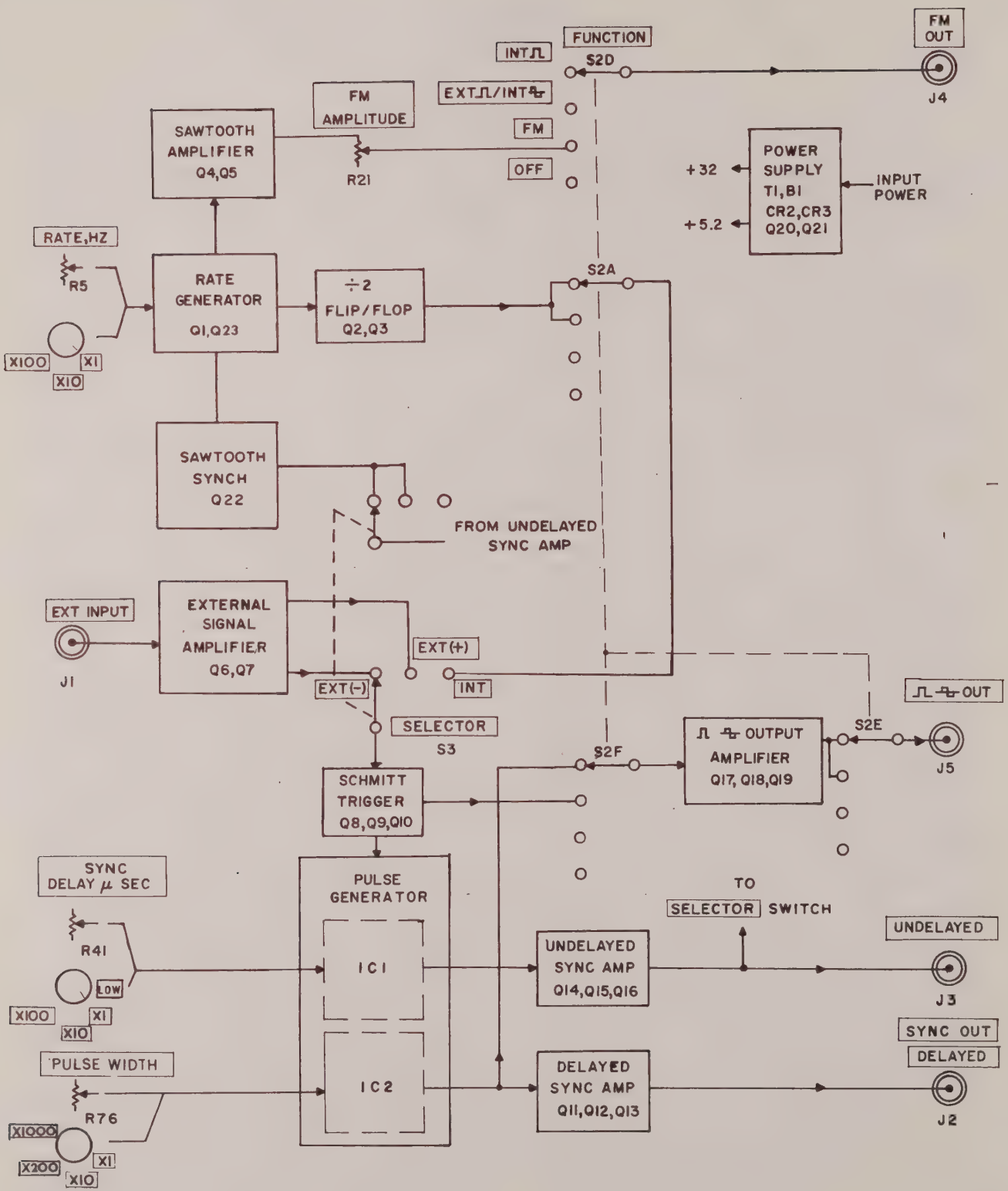


Figure 3-1. Model 1020A Modulator, Block Diagram

the FUNCTION switch to the INT position of the SELECTOR switch S3. When the SELECTOR switch is in the INT position the square wave is fed to the Schmitt Trigger circuit for further processing.

3-10. SCHMITT TRIGGER Q8, Q9, Q10. The input to the Schmitt Trigger is determined by the position of the SELECTOR switch. When the SELECTOR switch is in its INT position, a square wave from the ÷ 2 Flip/Flop will be applied to the input. When the SELECTOR switch is in its EXT - or EXT + position the output of the Ext Sig Amplifier will be applied to the input. The output waveform of the Ext Sig Amplifier will depend upon the type of signal waveform connected to the EXT SYNC connector J1. The Schmitt Trigger circuit composed of Q8 and Q9 is a dc coupled amplifier used to improve the rise and fall time of the input waveform. Q10 is an emitter follower used to provide a low output impedance for the circuit. A positive going signal will provide a positive going signal at the emitter of Q9. The Schmitt Trigger provides two outputs; a square wave which is direct coupled through the FUNCTION switch, when it is in its EXT ⎍ /INT ⊓ position, to the ⎍ ⊓ Output Amplifier. The other output is differentiated by C16 and R38 and routed to the Pulse Generator for pulse shaping and delay.

3-11. PULSE GENERATOR IC1, IC2. The Pulse Generator consists of two integrated monostable multivibrators IC1 and IC2. As the integrated circuits are connected, they require a positive going signal to activate the output. The positive going output of the Schmitt Trigger used to initiate pulse generation is differentiated by C16 and R38 and applied to the input of IC1. The pulse output of IC1 is a negative going waveform whose duration is determined by C17, C18, C38 or C39, C40 and the front panel SYNC DELAY controls R41 and S4. The output pulse of IC1 is differentiated by C19 and R42, the leading or negative going edge is routed to the Undelayed Sync Amp while the positive going edge, which represents the fall of the pulse developed by IC1, is connected to the input of IC2. The positive input to IC2 initiates pulse generation by IC2 which is a positive going waveform whose duration is the output pulse width determined by C36, C37, C48 or C49/C50 and PULSE WIDTH, R76 and S7. The duration of the pulse generated by IC1 therefore represents the delay time between the undelayed sync pulse and the output and delayed sync pulse. The leading edge of the output pulse and the delayed sync pulse are coincident.

3-12. UNDELAYED SYNC AMP Q14, Q15, Q16. The undelayed sync amplifier input transistor Q14, a pnp type, is quiescently cut off. The negative going pulse from the differentiating network of C19 and R42 causes Q14 to conduct allowing the collector to go positive causing Q15 to conduct dropping its collector to ground potential. When the collector of Q15 assumes its low potential state Q16 conducts allowing its collector to go positive and somewhat less than +32 volts. The collector of Q16 is connected to the UNDELAYED SYNC OUT connector J3 through R73.

3-13. DELAYED SYNC AMP Q11, Q12, Q13. The delayed sync amplifier input transistor Q11, an npn type, is quiescently cut off. The positive going pulse from the differentiating network of C25 and R57 causes Q11 to conduct and develop a positive going signal across R58. The positive potential applied to Q12, which is also quiescently cut off causes Q12 to conduct dropping its collector to ground potential. When the collector of Q12 assumes its low potential state Q13 conducts allowing its collector to go positive and somewhat less than +32 volts. The collector of Q13 is connected to the DELAYED SYNC OUT connector J2 through R62.

3-14. ⎍ ⊓ OUTPUT AMPLIFIER Q17, Q18, Q19. The ⎍ ⊓ output amplifier input transistor, Q17, is quiescently cut off and is caused to conduct by applying positive going waveforms to its base. Q18, a pnp type, and Q19, an npn type, act in a complementary fashion. When Q17 is in cutoff Q18 is also cut off and Q19 is conducting maintaining the output seen at OUT output connector J5 at ground potential. When Q17 conducts it causes Q18 to conduct and Q19 to be cut off allowing the output to rise to a positive level somewhat less than +32 volts.

3-15. EXT INPUT AMPLIFIER Q6, Q7. The external input applied to the ext input amplifier is applied to the EXT INPUT connector J1. The input signal is coupled through the network of R22 and C12 and applied to the gate of Q6. The signal appearing at the gate of Q6 may be positive or negative and is held to a potential of approximately 2.4 volts due to the clamping action of diodes CR5 through C12. The drain of Q6 is coupled to paraphase amplifier Q7 which will provide two signals of opposing phase to the front panel SELECTOR switch S3.

3-16. SAWTOOTH AMPLIFIER Q4, Q5. The input to the sawtooth amplifier is a positive going sawtooth waveform developed across the capacitors in the emitter circuit of the Rate Generator. Q4 is an emitter follower applying a positive going sawtooth waveform to Q5. The positive going waveform causes Q5 to conduct developing a negative going sawtooth which is applied across front panel FM DEV AMPLITUDE control R21. The wiper arm of R21 routes the output sawtooth waveform through the FUNCTION switch to the FM OUT connector J4. The emitter resistor of Q4 is a potentiometer and is adjusted to achieve a proper base level for the output sawtooth. This adjustment is described in paragraph 4-14.

3-17. POWER SUPPLY. The power supply develops two regulated dc voltages; +32 volts and +5.2 volts. The input power is routed through cable W1, power switch S6, fuse F1, voltage selector switch S5 to transformer T1. T1 steps the input voltage down to the required level which is then full-wave rectified by bridge B1. The output of B1 is applied to the collector of Q20, the +32 volt output transistor. The base of Q20 is held at +33 volts by zener diode CR2.

The +32 volt output appears at the emitter of Q20 and is distributed throughout the modulator circuitry. The +32 volt output is also applied to the collector of Q21, the +5.2 volt output transistor. The base of Q21 is held at +6 volts by zener diode CR3. The +5.2 volt output appears at the emitter of Q21 and is used primarily in the pulse generator circuitry which utilizes integrated circuits.

SECTION IV

MAINTENANCE

4-1. GENERAL.

4-2. This section contains maintenance and alignment procedures for the Model 1020A Modulator. Included are a list of test equipment required, minimum performance standards that are used to ascertain equipment capability, and troubleshooting procedures.

4-3. TEST EQUIPMENT REQUIRED.

4-4. The test equipment required for maintenance and adjustment of the Model 1020A is listed in Table 4-1.

4-5. MINIMUM PERFORMANCE STANDARDS.

4-6. The purpose of the minimum performance standards listed in Table 4-2 is to determine if the Model 1020A is operating in compliance with the specifications listed in Section I.

4-7. TROUBLESHOOTING.

4-8. Should the Model 1020A fail to meet any of the minimum performance standards given in Table 4-2, the trouble may be determined and corrected through the use of Table 4-2 by following the instructions given in the "If Indication is Abnormal" column. The Model 1020A Block Diagram and Schematic, figures 3-1 and 5-1 respectively, should be referred to when troubleshooting.

4-9. DISASSEMBLY AND REASSEMBLY INSTRUCTIONS. (See Figures 4-2 and 4-3.)

4-10. The top which forms the dust cover for the Model 1020A, is removed by unscrewing the two screws which hold the top cover in place, thereby making adjustments and components accessible.

4-11. ADJUSTMENT PROCEDURES.

4-12. Adjustment procedures for the Model 1020A are given in paragraphs 4-13 and 4-14.

4-13. SETTING HIGH REPETITION RATE ADJ. CONTROL R6. To adjust the repetition rate of the rate generator at the high repetition rate, proceed as follows:

a. Set the FUNCTION switch to its EXT ⎍ /INT ⎓ position.

b. Set the SELECTOR switch to INT.

c. Set the RATE control fully clockwise.

d. Set the RATE X1-X10-X100 multiplier switch to X100.

e. Connect the Model 7370R electronic counter to the ⎍⎓ OUT connector.

f. Note the indication of the electronic counter. It should indicate a repetition rate of 10,000 pps. If it does not, proceed to step g.

g. Adjust R6 to obtain an electronic counter indication of 10,000 pps.

4-14. SETTING THE FM SAWTOOTH BASELINE CONTROL, R17. To adjust the FM sawtooth baseline, proceed as follows:

a. Set the Function switch to its FM position.

b. Set the SELECTOR switch fully clockwise.

c. Set the RATE control to 100.

d. Set the RATE X1-X10-X100 multiplier switch to X100.

e. Connect the Model 545A Oscilloscope to the FM OUT connector.

f. Turn the FM DEV AMPLITUDE control fully clockwise. Note the display on the oscilloscope. The sawtooth wave form displayed should be as shown in figure 4-1A with no flat portions. If it does not, but looks like figure 4-1B, proceed to step g.

g. Adjust R17 to obtain the waveform shown in figure 4-1A.

4-15. PREVENTIVE MAINTENANCE.

4-16. PERIODIC INSPECTION. Table 4-3 contains the criteria for a visual inspection. A regular schedule for this inspection should be adhered to so that minor faults can be caught and corrected before more serious damage results.

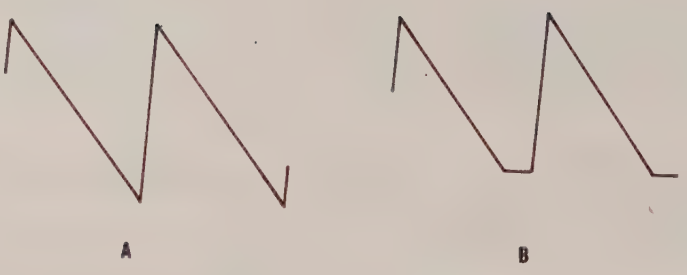


Figure 4-1. FM Sawtooth Baseline Waveforms

TABLE 4-1. TEST EQUIPMENT REQUIRED OR EQUIVALENT

Name	Manufacturer and Model No.	Use
Multimeter	Triplett 630	Checking voltages and resistances
Oscilloscope	Tektronix 545A	Checking waveshapes
Multipulse Generator	Polarad MP-1A	Checking external sync
Frequency Counter	Berkeley 7370R	Adjusting rate generator
Variac	General Radio W5MT3A	Adjusting line voltage
Plug-in	Tektronix Type CA	Checking waveshapes

NOTE

If a potentiometer is replaced on the printed-circuit board, rotate its arm to the center of its range before applying power to the equipment.

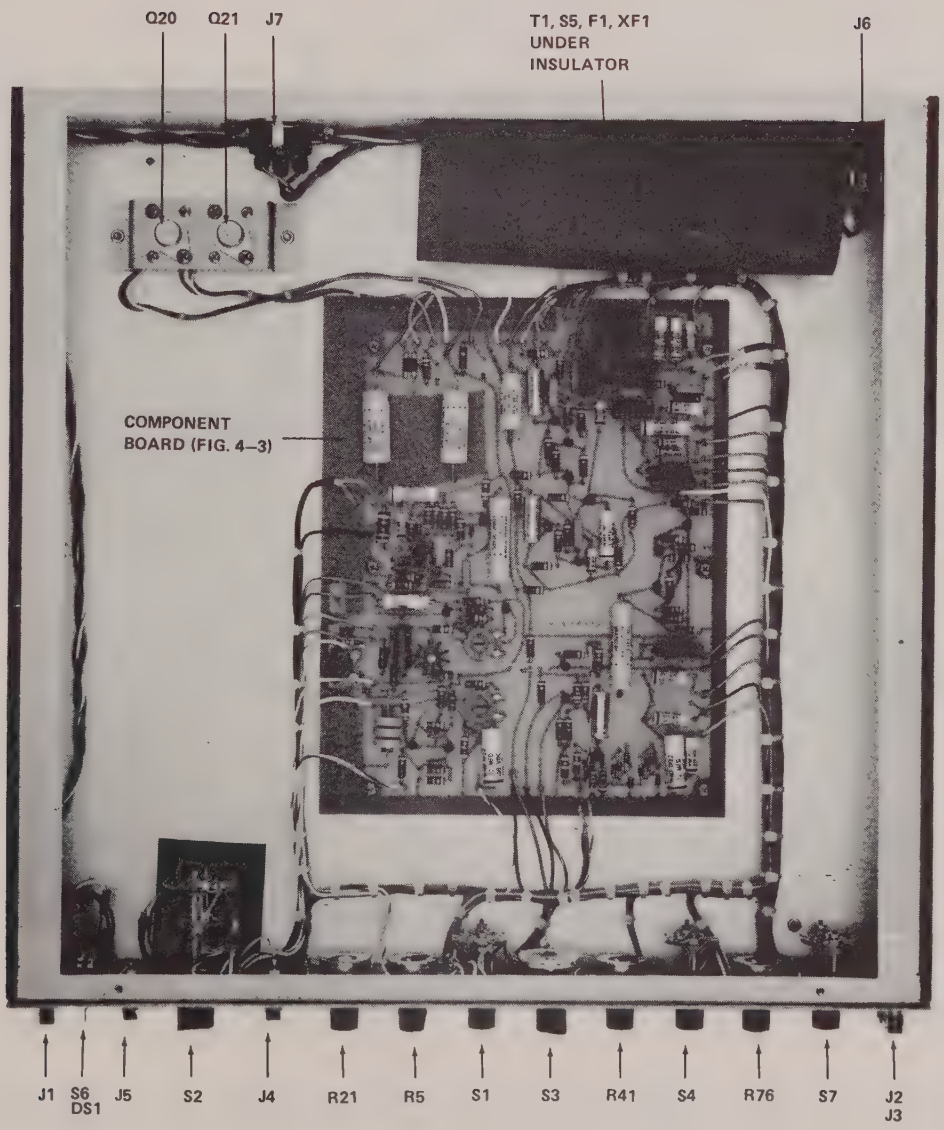


Figure 4-2. Top View of Chassis, Model 1020A Modulator

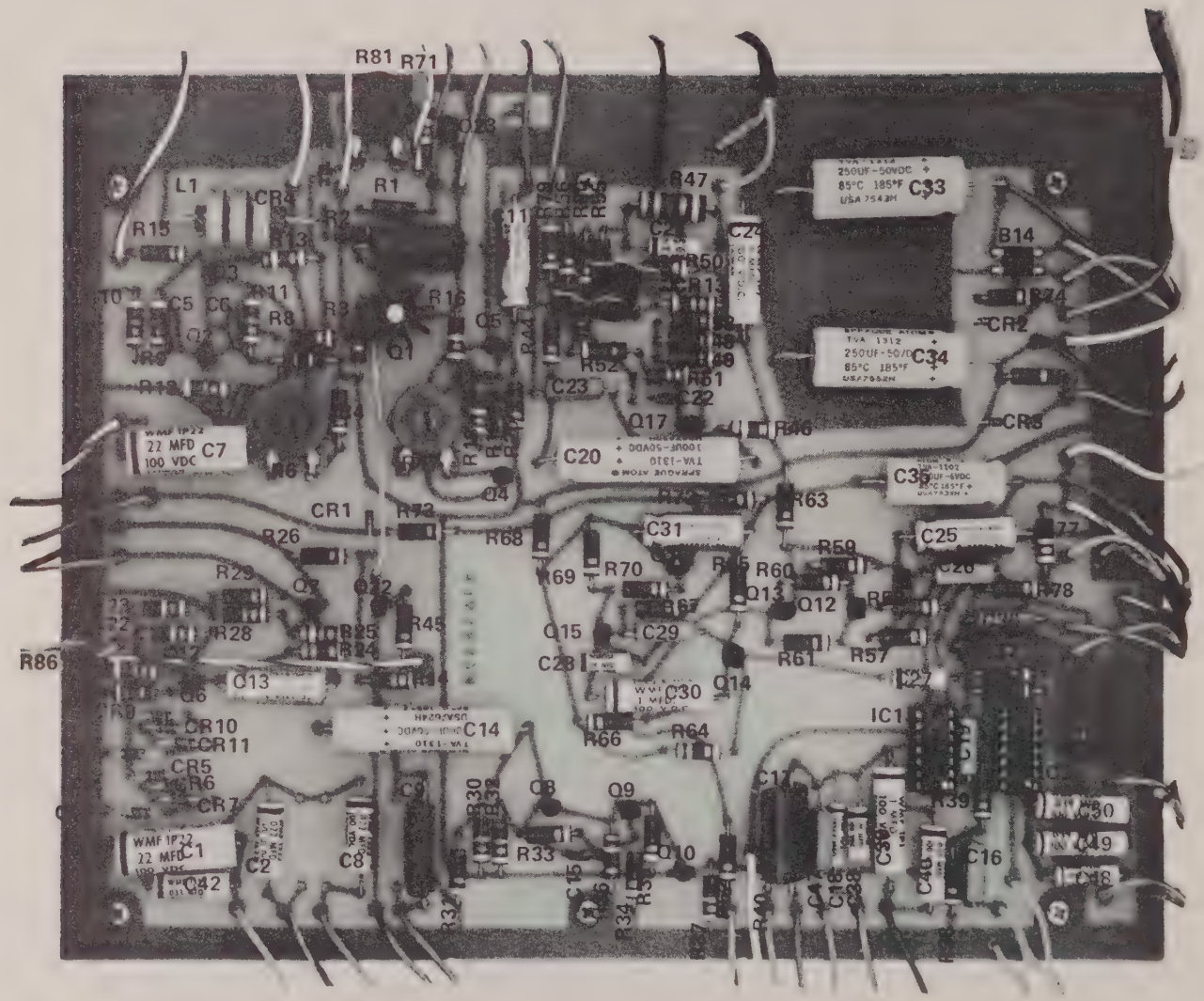


Figure 4-3. Printed Circuit Board Component Layout

TABLE 4-2. MINIMUM PERFORMANCE STANDARDS

Step	Purpose	Procedure	Normal Indication	If Indication is Abnormal
1	To evaluate operating power conditions.	Connect power cable (and adaptor, if necessary) to power source outlet. Set power switch to ON.	Power indicator lights.	Check DS1, 115/230 voltage selector switch, F1, power switch and power cable W1.
2	To evaluate FM operation.	Couple FM OUT connector on the Model 1020A front panel to the vertical input terminals of the Model 545A oscilloscope and proceed as follows: a. Set the FUNCTION switch to FM. b. Set SELECTOR switch to INT. c. Rotate FM OUTPUT control fully clockwise. d. Set RATE control and multiplier switch as follows and note repetition rates on the oscilloscope screen: RATE Control / Multiplier Switch 10 / X1 100 / X100	A sawtooth waveshape appears on the oscilloscope screen. Repetition rate is adjustable from 10 to 10,000 sweeps/sec. 10 sweeps/sec 10,000 sweeps/sec	No Output a. Check power supply for +32v ±5%. b. Check FUNCTION switch S2, wafer D. c. Check FM AMPLITUDE control R21. d. Check Sawtooth Amplifier, Q4, Q5. e. Check Rate Generator Q1. Incorrect Repetition Rate a. Check power supply for +32v ±5%. b. Check FUNCTION switch S2, wafers A and C. c. Check RATE control R5 and multiplier switch S1. d. Check high repetition rate adjustment R6 as per the procedure given in paragraph 4-13.
3	To evaluate internal square wave operation.	Couple ⎍⎍ OUT connector to the vertical input terminals of the oscilloscope and proceed as follows: a. Set the FUNCTION switch to EXT ⎍/INT ⎍ b. Set SELECTOR switch to INT. c. Set RATE control and multiplier switch as follows and note display on the oscilloscope screen: RATE Control / Multiplier Switch 10 / X1 100 / X100	Square wave frequency is variable from 10 to 10,000 Hz. 10 sweeps/sec 10,000 sweeps/sec	No Output a. Check power supply for +32v ±5%. b. Check FUNCTION switch, wafer E. c. Check ⎍⎍ Output Amplifier Q17, Q18, Q19. d. Check FUNCTION switch S2, wafer F. e. Check Schmitt Trigger Q8, Q9, Q10. f. Check SELECTOR switch S3. g. Check FUNCTION switch S2, wafer A.

TABLE 4-2. MINIMUM PERFORMANCE STANDARDS (Cont'd)

Step	Purpose	Procedure	Normal Indication	If Indication is Abnormal
3 Cont				h. Check ÷ 2 Flip/Flop Q2, Q3. i. Check Rate Generator Q1. Incorrect Repetition Rate a. Check power supply for +32v ±5%. b. Check RATE control R5 and multiplier switch S1. c. Check high repetition rate adjustment R6 as per the procedure given in paragraph 4-13. d. Check ÷ 2 Flip/Flop Q2, Q3.
4	To evaluate internal pulse operation.	Couple ⎍⎓ OUT connector to the vertical input terminals of the oscilloscope and proceed as follows: a. Set the FUNCTION switch to INT. b. Set SELECTOR switch to INT. c. Rotate DELAY uSEC control fully counterclockwise and the multiplier switch to X1. d. Adjust PULSE WIDTH control, RATE control and multiplier switch as follows and note displays on the oscilloscope screen: PULSE WIDTH Control / RATE Control / RATE Multiplier Switch 0.2 / 10 / X1 0.2 / 100 / X100 200 / 10 / X1	Pulse width variable from .2 to 2000 microseconds. Pulse repetition rate variable from 10 to 10,000 pps. 0.2 uS 10 pps 0.2 uS 10,000 pps 2000 uS 10pps	No Output a. Check power supply for +5.2 volts and +32 volts ±5%. b. Check FUNCTION switch S2, wafer E. c. Check ⎍⎓ Output Amplifier Q17, Q18, Q19. d. Check FUNCTION switch S2, wafer F. e. Check IC2. f. Check IC1. g. Check Schmitt Trigger Q8, Q9, Q10. h. Check SELECTOR switch S3. i. Check ÷ 2 Flip/Flop Q2, Q3. j. Check Rate Generator Q1.

TABLE 4-2. MINIMUM PERFORMANCE STANDARDS (Cont'd)

Step	Purpose	Procedure	Normal Indication	If Indication is Abnormal
4 Cont				Incorrect Repetition Rate a. Check power supply for +32v ±5%. b. Check Rate control R5 and multiplier switch S1. c. Check high repetition rate adjustment R6 as per the procedure given in paragraph 4-13. d. Check ÷ 2 Flip/Flop. Incorrect Pulse Width a. Check power supply for +5.2 volts ±5%. b. Check PULSE WIDTH control R76. c. Check IC2.
5	To evaluate external input signal operation. (External synchronization).	Connect EXT INPUT connector to the Multipulse Generator Model MP-1A and ⎍⎓ OUT connector to the vertical input terminals of the oscilloscope. Proceed as follows and note the displays on the oscilloscope screen: a. Set the FUNCTION switch to INT b. Set SELECTOR switch to EXT (+). c. Adjust PULSE WIDTH control and the Multipulse Generator Repetition Rate control as follows and note the displays on the oscilloscope screen: PULSE WIDTH Control / Rate Generator Repetition Rate Control 0.2 / 10 10 / 10 0.2 / 100 10 / 100	Pulse width of externally synchronized output pulse is adjustable from 0.2 to 2000 microseconds. Repetition rate is determined by that of the external pulse generator. NOTE Do not exceed duty cycle. Refer to figure 2-4. 0.2 uS 10 pps 10 uS 10 pps 0.2 uS 100 pps 10 uS 100 pps	No Output a. Check power supply for +5.2 volts ±5% and +32 volts ±5%. b. Check FUNCTION switch S2, wafer E. c. Check ⎍⎓ Output Amplifier Q17, Q18, Q19. d. Check FUNCTION switch S2, wafer F. e. Check IC2. f. Check IC1. g. Check Schmitt Trigger Q8, Q9, Q10. h. Check SELECTOR switch S3. i. Check EXT Input Amplifier Q6, Q7.

TABLE 4-2. MINIMUM PERFORMANCE STANDARDS (Cont'd)

Step	Purpose	Procedure	Normal Indication	If Indication is Abnormal
5 Cont				Incorrect Pulse Width a. Check power supply for +5.2 volts ±5%. b. Check PULSE WIDTH control R76. c. Check IC2.
6	To evaluate characteristics of undelayed sync output pulse.	Couple UNDELAYED SYNC OUT connector to the vertical input terminals of the oscilloscope. Program the Model 1020A for internal pulse operation. (Refer to paragraph 2-12.) Note oscilloscope displays for the following settings of RATE control and multiplier switch: RATE Control — Multiplier Switch 10 — X1 100 — X100	Pulse obtained is +25 volts peak (minimum) and has a rise time of 0.1 to 1.0 microsecond. Pulse repetition rate is variable from 10 to 10,000 pps. 10 pps 10,000 pps	No Output a. Check power supply for +5.2 volts ±5% and +32volts ±5%. b. Check Undelayed Sync Amp Q14, Q15, Q16. c. Check IC1. d. Check Schmitt Trigger Q8, Q9, Q10. e. Check SELECTOR switch S3. f. Check ÷2 Flip/Flop Q2, Q3. g. Check FUNCTION switch S2, wafer A. h. Check Rate Generator Q1. Incorrect Repetition Rate a. Check power supply for +32v ±5%. b. Check Rate control R5 and multiplier switch S1. c. Check high repetition rate adjustment R6 as per the procedure given in paragraph 4-13. d. Check ÷2 Flip/Flop.

TABLE 4-2. MINIMUM PERFORMANCE STANDARDS (Cont'd)

Step	Purpose	Procedure	Normal Indication	If Indication is Abnormal
7	To evaluate characteristics of delayed sync output pulse.	Connect DELAYED SYNC OUT connector to the vertical input terminals of the oscilloscope and UNDELAYED SYNC OUT connector to the external trigger terminals of the oscilloscope. Program the Model 1020A for internal pulse operation. (Refer to paragraph 2-12.) Set RATE control to 100 and multiplier switch to X1 and note oscilloscope displays for the following settings of DELAY uSEC control and amplifier switch: DELAY uSEC Control / Multiplier Switch 2 / LOW 20 / X100	Pulse obtained is +25 volts peak (minimum) and has a rise time of 0.1 to 1.0 microseconds. Delay variable from .3 to 2000 microseconds. 0.3 microseconds maximum 2000 microseconds minimum	No Output a. Check power supply for +5.2 volts ±5% and +32 volts ±5%. b. Check Delayed Sync Amp **Q11, Q12, Q13.** c. Check IC2. d. Check IC1. e. Check Schmitt Trigger Q8, Q9, Q10. f. Check SELECTOR switch S3. g. Check FUNCTION switch S2, wafer A. h. Check ÷2 Flip/Flop **Q2, Q3.** i. Check Rate Generator Q1. Incorrect Delay a. Check power supply for +5.2 volts ±5%. b. Check DELAY uSEC control R41 and multiplier switch S4. c. Check IC1.
8	To evaluate external pulse operation. For pulse modulation programmed from an external pulse source.	Connect EXT INPUT connector to the Multipulse Generator Model MP-1A and ⎍ ⊓ OUT connector to the vertical input terminals of the oscilloscope. Proceed as follows and note the display on the oscilloscope screen: a. Set the FUNCTION switch to EXT ⎍ /INT ⊓ b. Set SELECTOR switch to EXT (+) or EXT (-).	Pulse width and repetition rate is determined by the external pulse source within the following: Pulse Width: 0.5 to 2500 uS Rep Rate: Single pulse to 1 MHz. NOTE Do not exceed duty cycle. Refer to figure 2-4.	Follow procedure given for step 5, omitting procedural steps e, and f.

TABLE 4-3. PERIODIC INSPECTION

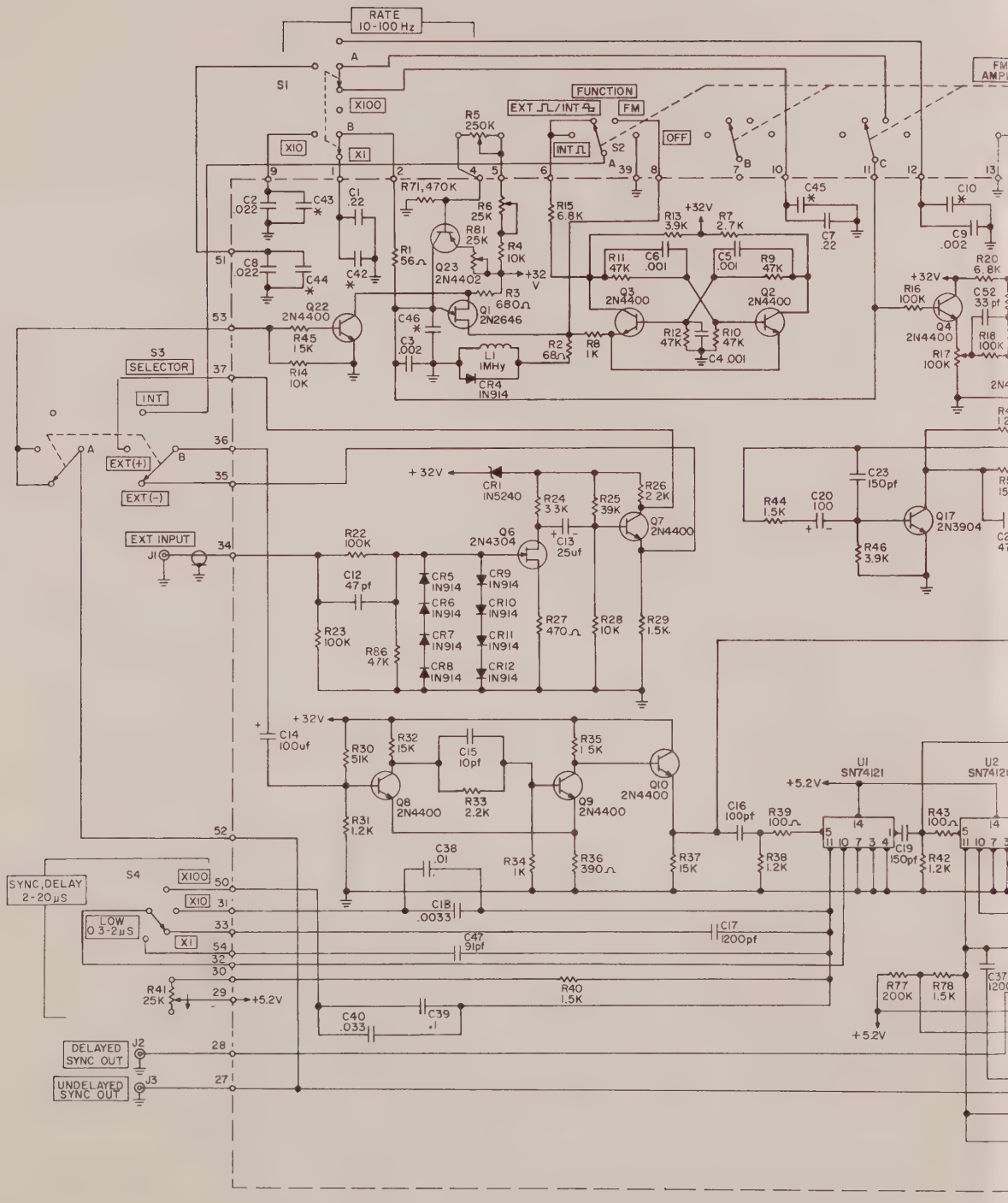
Item	Inspect For	Inspection Interval
Case and panel	Dirt or corrosion; dents, cracks, scratches, or other physical damage; loose or missing hardware.	Monthly
Switches and potentiometers	Loose or missing knobs; defective switch action; loose mounting; bent, broken or loose terminals; proper detent or snap action; smooth potentiometer rotation from stop to stop; cracked, damaged.	Weekly
Connectors	Bent, broken, or corroded pins; damaged threads; cracked shell; loose or missing hardware.	Monthly
Panel lamps	Cracked or broken lens; missing or defective lamps; loose or missing hardware; bent, broken, or corroded terminals.	Weekly
Wiring	Frayed, broken, or abraded insulation; loose connections; broken wires.	Monthly
Electrical parts	Loose connections or mounting; evidence of overheating such as being cracked, broken, blistered or charred.	Monthly
Cables	Frayed, broken, kinked, or abraded insulation; loose or missing clamps; broken wires; damaged connectors.	Weekly
Fuses	Cracked, damaged, or corroded fuse holders and fuses; correct current rating of fuses; fuse holders securely mounted.	Monthly

SECTION V

SCHEMATIC DIAGRAMS

5-1. GENERAL.

5-2. This section contains the schematic diagram for the Model 1020A.


RATE
10-100 Hz
S1
X100
X10
X1
FUNCTION
EXT ⎍/INT
FM
INT ⎍
OFF
S2
R5
250K
R71, 470K
R6
25K
R81
25K
R4
10K
R1
56Ω
Q23
2N4402
+32
V
R3
680Ω
Q1
2N2646
L1
1MHy
CR4
IN914
R2
68Ω
R8
1K
C1
.22
C2
.022
C43
C8
.022
C44
C42
C46
C3
.002
Q22
2N4400
R45
15K
R14
10K
R15
6.8K
+32V
R13
3.9K
R7
2.7K
R11
47K
C6
.001
C5
.001
R9
47K
Q3
2N4400
Q2
2N4400
R12
47K
R10
47K
C4 .001
C45
C7
.22
C10
C9
.002
R20
6.8K
R16
100K
C52
33pf
Q4
2N4400
R18
100K
R17
100K
S3
SELECTOR
INT
EXT(+)
EXT(-)
EXT INPUT
J1
+32V
CR1
IN5240
R24
3.3K
R25
39K
R26
2.2K
Q7
2N4400
Q6
2N4304
C13
25uf
R22
100K
C12
47pf
R23
100K
R86
47K
CR5
IN914
CR6
IN914
CR7
IN914
CR8
IN914
CR9
IN914
CR10
IN914
CR11
IN914
CR12
IN914
R27
470Ω
R28
10K
R29
1.5K
C23
150pf
R44
1.5K
C20
100
Q17
2N3904
R46
3.9K
+32V
C14
100uf
R30
51K
R32
15K
C15
10pf
R33
2.2K
R35
1.5K
Q8
2N4400
Q9
2N4400
Q10
2N4400
R31
1.2K
C38
.01
R34
1K
R36
390Ω
R37
15K
R38
1.2K
C16
100pf
R39
100Ω
U1
SN74121
U2
SN74121
+5.2V
R43
100Ω
C19
150pf
R42
1.2K
S4
SYNC, DELAY
2-20μS
X100
X10
X1
LOW
0.3-2μS
C18
.0033
C47
91pf
C17
1200pf
R41
25K
+5.2V
R40
1.5K
C40
.033
C39
.1
R77
200K
R78
1.5K
+5.2V
DELAYED
SYNC OUT
J2
UNDELAYED
SYNC OUT
J3

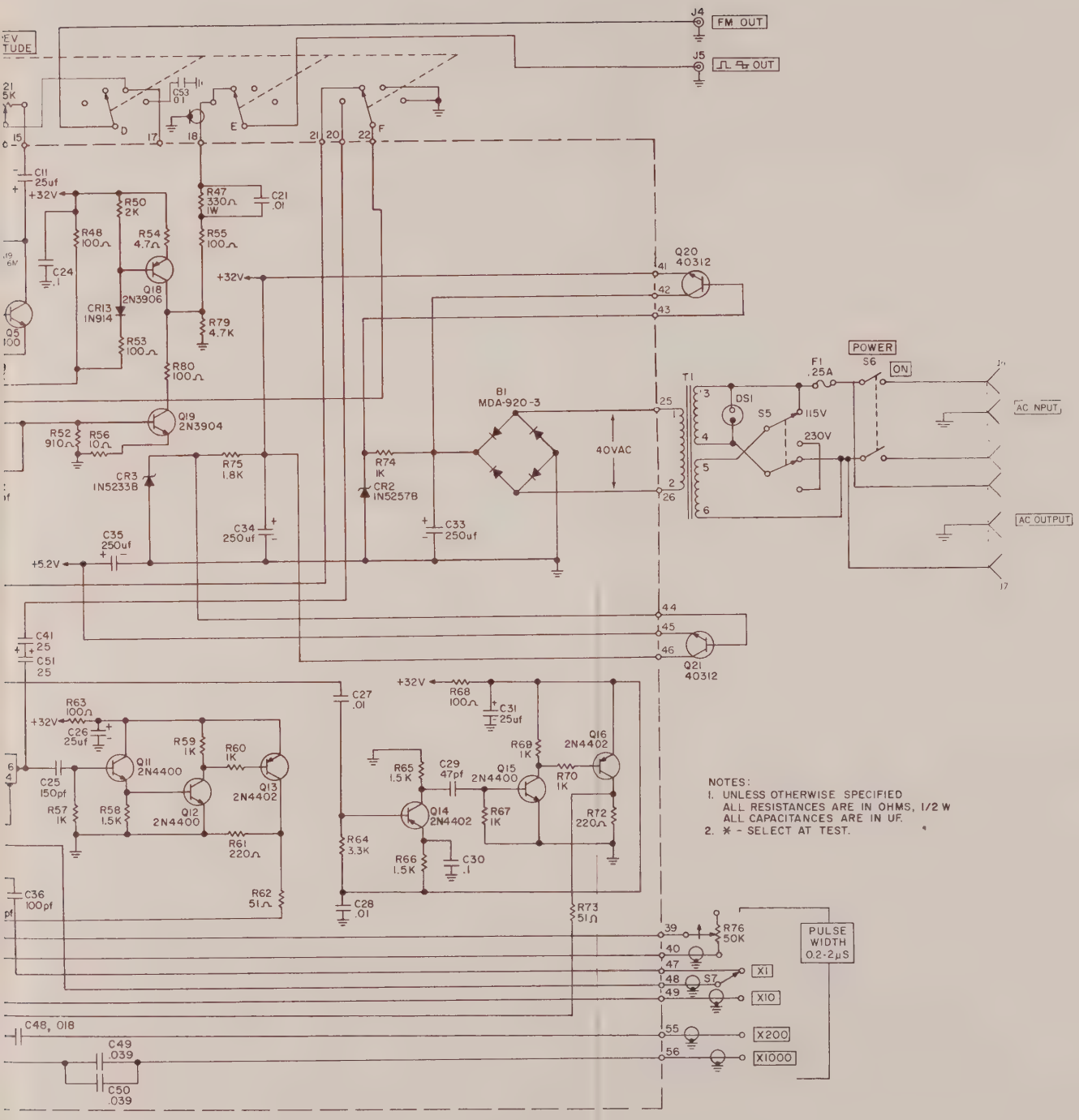


Figure 5-1. Model 1020A Modulator, Schematic Diagram

SECTION VI

PARTS LIST

6-1. INTRODUCTION.

6-2. This parts list provides an alpha-numerical listing, in reference symbol sequence of the replaceable electrical, certain electro-mechanical, and mechanical parts of the equipment.

6-3. ORDERING INFORMATION. Orders for parts should contain the following information:

a. Equipment name and model.

b. Serial number.

c. Reference symbol of part.

d. Manufacturer's part number and MSC.

6-4. HOW TO USE THE PARTS LIST

6-5. An explanation of the structure of the parts list, Table 6-2, and the meaning of the entries in the five columns are given in the following paragraphs. (See Figure 6-1.)

TABLE 6-2. PARTS LIST

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR'S MSC	UNITS PER ASSY
C101	CAPACITOR, CERAMIC, 2000UUF, 10 PCT, 500WVDC /POLARAD PART NO. B704888	BCD-D1-4	00656	1
C102	NOT USED			
C103 AND C104	SAME AS C101			
S101 THRU S104	SWITCH, ROTARY, 4 SECT, 8 WAFERS, 6 POSITIONS	C23346	82199	1
TB101	TERMINAL BOARD, COMPONENT ASSY	C115625	82199	1
W108	CABLE ASSY, RF	C147158	82199	1
XF101 AND XF102	FUSEHOLDER	HKP-HW	71400	1

Figure 6-1. Parts List Example

6-6. REFERENCE SYMBOL COLUMN. The reference symbol column (1, Figure 6-1) contains the reference symbol assigned to each part, which also identifies the part on the schematic diagram or in an illustration. The listing is in alpha-numerical order.

6-7. DESCRIPTION COLUMN. The description column (2) contains the description for each part. When the same part is used more than once in the equipment, the second and subsequent listings for that part use the phrase "SAME AS " (4) in the description column and the remaining columns (5, 6, and 7) are left blank. When a reference symbol designation has not been used or its assignment has been cancelled, the description column contains the phrase "NOT USED" (3).

6-8. MANUFACTURER'S PART NUMBER COLUMN. The manufacturer's part number column (5) contains the part number assigned by the manufacturer of the part, except for "SAME AS" and "NOT USED" listings.

6-9. MANUFACTURER'S SUPPLY CODE (MSC) COLUMN. The manufacturer's supply code column (6) contains a 5 digit number code identifying the manufacturer of the part. Table 6-1 contains a listing of the codes and the manufacturer's names and addresses.

6-10. UNITS PER ASSEMBLY COLUMN. The units per assembly column indicates the quantity of each part contained in the respective assembly or subassembly listed as shown in (7).

TABLE 6-1. LIST OF MANUFACTURERS

MFR CODE	NAME AND ADDRESS
00853	Sangamo Electric Co. S. Carolina Div. Pickens, S.C.
01295	Texas Instruments Inc. Semiconductor Div. Dallas, Texas 75231
02929	Nework Electronics Corp. 500 N. Pulaski Road Chicago, Ill. 60624
04713	Motorola Semiconductor Products, Inc. 5005 East McDowell Road Phoenix, Arizona 85008
09214	General Electric Co. Semi-Conductor Products Dept. West Genesee Street Auburn, N.Y. 31022
11237	CTS Electronics Inc. 1010 Sycamore Ave. So. Pasadena, Calif. 91030
14655	Cornell-Dubilier Electronics Division Federal Pacific Electric Co. 50 Parts St. Newark, N.J. 07105
56289	Sprague Electric Co. Marshall St. North Adams, Mass. 01247
71590	Globe-Union, Ind., Centralab Division P.O. Box 591 Milwaukee, Wis. 53201
75042	TRW, Inc., IRC Division 401 North Broad St. Philadelphia, Pa. 19108
75915	Littlefuse, Inc. 800 E. Northwest Hwy. Des Plaines, Ill. 60016
81349	Military Specification promulgated by Standardization Div., Directorate of Logistics Services DSA
82389	Switchcraft, Inc. 555 N. Elston Ave. Chicago, Ill.
82199	Polarad Electronics Corporation 5 Delaware Drive Lake Success, New York 11040
91737	ITT Gremar Inc. 10 Micro Drive Woburn, Mass. 01801
93332	Sylvania Electric Products Inc. Semiconductor Products Division 100 Sylvan Rd. Woburn, Mass. 01801
95146	ALCO Electronic Products Inc. P.O. Box 1348 Lawrence, Mass. 01843
99999	Electronic Hardware Inc. 180-08 Liberty Ave. Jamaica, N.Y.

TABLE 6-2. PARTS LIST

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	UNITS PER ASSY
B1	BRIDGE, RECTIFIER	MDA920-3	04713	1
CR1	SEMICONDUCTOR DEVICE, DIODE, ZENER	1N5240	04713	1
CR2	SEMICONDUCTOR DEVICE, DIODE, ZENER	1N5257B	04713	1
CR3	SEMICONDUCTOR DEVICE, DIODE, ZENER	1N5233B	04713	1
CR4	SEMICONDUCTOR DEVICE, DIODE	1N914	93332	10
CR5	SAME AS CR4			
CR6	SAME AS CR4			
CR7	SAME AS CR4			
CR8	SAME AS CR4			
CR9	SAME AS CR4			
CR10	SAME AS CR4			
CR11	SAME AS CR4			
CR12	SAME AS CR4			
CR13	SAME AS CR4			
C1	CAPACITOR, FIXED, 0.22 UF, ±10%, 100 VDCW	WMF1P22	14655	2
C2	CAPACITOR, FIXED, MYLAR, 0.022 UF, 100 VDCW	WMF1S22	14655	2
C3	CAPACITOR, FIXED, MICA, 0.002 UF, ±5%, 200 VDCW	CD19FD202J03	00853	2
C4	CAPACITOR, FIXED, CERAMIC, 0.001 UF, ±10%, 600 VDCW	DD102	71590	3
C5	SAME AS C4			
C6	SAME AS C4			
C7	SAME AS C1			
C8	SAME AS C2			
C9	SAME AS C3			
C10	SELECT AT TEST			
C11	CAPACITOR, FIXED, ELECTROLYTIC, 25 UF, 50 VDCW	TE13055	56289	4
C12	CAPACITOR, FIXED, CERAMIC, 47 PF, ±10%, 600 VDCW	DD470	71590	2
C13	SAME AS C11			
C14	CAPACITOR, FIXED, ELECTROLYTIC, 100 UF, 50 VDCW	TVA1310	56289	2
C15	CAPACITOR, FIXED, CERAMIC, 10 PF, ±10%, 600 VDCW	DD100	71590	1
C16	CAPACITOR, FIXED, MICA, 100 PF, ±5% 300 VDCW	CM15E101J	81349	2
C17	CAPACITOR, FIXED, MICA, 1200 PF, ±5%, 200 VDCW	CD19FD122J03	81349	2
C18	CAPACITOR, FIXED, MYLAR, 0.0033 UF, ±10%, 100 VDCW	WMF1D33	14655	1
C19	CAPACITOR, FIXED, MICA, 150 PF, ±5%, 300 VDCW	CM15E151J	81349	3
C20	SAME AS C14			

TABLE 6-2. PARTS LIST (Continued)

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	UNITS PER ASSY
C21	CAPACITOR, FIXED, MYLAR, 0.01 UF, ±10%, 100 VDCW	WMF1S1	14655	4
C22	SAME AS C12			
C23	SAME AS C19			
C24	CAPACITOR, FIXED, 0.1 UF, ±10%, 100 VDCW	WMF1P1	14655	3
C25	SAME AS C19			
C26	SAME AS C11			
C27	SAME AS C21			
C28	SAME AS C21			
C29	CAPACITOR, FIXED, MICA, 47 PF, ±5%, 300 VDCW	CM15E470J	81349	1
C30	SAME AS C24			
C31	SAME AS C11			
C32	NOT USED			
C33	CAPACITOR, FIXED, ELECTROLYTIC, 250 UF, 50 VDCW	TVA1312	56289	2
C34	SAME AS C33			
C35	CAPACITOR, FIXED, ELECTROLYTIC, 250 UF, 6 VDCW	TVA1102	56289	1
C36	SAME AS C16			
C37	SAME AS C17			
C38	SAME AS C21			
C39	SAME AS C24			
C40	CAPACITOR, FIXED, MYLAR, 0.033 UF, ±10%, 100 VDCW	WMF1S33	14655	1
C41	CAPACITOR, FIXED, ELECTROLYTIC, 25 UF, ±10%, 25 VDCW	500D256G025687	56289	2
C42	SELECT AT TEST			
C43	SELECT AT TEST			
C44	SELECT AT TEST			
C45	SELECT AT TEST			
C46	SELECT AT TEST			
C47	CAPACITOR, FIXED, MICA, 91 PF, ±5%, 300 VDCW	CM15E910J	81349	1
C48	CAPACITOR, FIXED, MYLAR, 0.018 UF, ±10%, 100 VDCW	WMF1S18	14655	1
C49	CAPACITOR, FIXED, MICA, 0.039 UF, ±10%, 100 VDCW	192P3932	56289	2
C50	SAME AS C49			
C51	SAME AS C41			
C52	CAPACITOR, FIXED, CERAMIC, 33 PF, ±10%, 300 VDCW	DD330	71590	1
C53	CAPACITOR, FIXED, 0.1 UF, 600 VDCW	DDG-103	71590	1
DS1	INDICATOR, LIGHT, NEON, 115-125 V, RED	A710147	82199	1

TABLE 6-2. PARTS LIST (Continued

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	UNITS PER ASSY
F1	FUSE, CARTRIDGE, 1/4 AMP	312.250	75915	1
J1	CONNECTOR, RECEPTACLE, ELECTRICAL, TYPE BNC	UG625B/U	91737	5
J2 thru J5	SAME AS J1			
J6	CONNECTOR, RECEPTACLE	EAC-201	82389	1
J7	CONNECTOR, RECEPTACLE	709781	82199	1
L1	CHOKE, 1 MHY, P1 WOUND	713765	82199	1
MP1 thru MP4	KNOB, ROUND	713395	82199	4
MP5 and MP6	KNOB, POINTER	713410	82199	2
MP7 thru MP9	KNOB, ROUND	7EC1B2	99999	3
Q1	TRANSISTOR	2N2646	09214	1
Q2	TRANSISTOR	2N4400	04713	12
Q3 thru Q5	SAME AS Q2			
Q6	TRANSISTOR	2N4304	04713	1
Q7 thru Q12	SAME AS Q2			
Q13	TRANSISTOR	2N4402	04713	4
Q14	SAME AS Q13			
Q15	SAME AS Q2			
Q16	SAME AS Q13			
Q17	TRANSISTOR	2N3904	04713	2
Q18	TRANSISTOR	2N3906	04713	1
Q19	SAME AS Q17			
Q20	TRANSISTOR	40312	04713	2
Q21	SAME AS Q20			
Q22	SAME AS Q2			
Q23	SAME AS Q13			
R1	RESISTOR, FIXED, COMPOSITION, 56 OHMS, ±5%, 1/2W	RC20GF560J	81349	1
R2	RESISTOR, FIXED, COMPOSITION, 68 OHMS, ±5%, 1/2W	RC20GF680J	81349	1
R3	RESISTOR, FIXED, COMPOSITION, 680 OHMS, ±5%, 1/2W	RC20GF681J	81349	1

TABLE 6-2. PARTS LIST (Continued)

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	UNITS PER ASSY
R4	RESISTOR, FIXED, COMPOSITION, 10K, ±5%, 1/2W	RC20GF103J	81349	3
R5	RESISTOR, VARIABLE, 250K, ±10%, 1/2W	PQ11-130	75042	1
R6	RESISTOR, VARIABLE, 25K, ±10%, 1/4W	U201R253B	11237	2
R7	RESISTOR, FIXED, COMPOSITION, 2.7K, ±5%, 1/2W	RC20GF272J	81349	1
R8	RESISTOR, FIXED, COMPOSITION, 1K, ±5%, 1/2W	RC20GF102J	81349	9
R9	RESISTOR, FIXED, COMPOSITION, 47K, ±5%, 1/2W	RC20GF473J	81349	5
R10	SAME AS R9			
R11	SAME AS R9			
R12	SAME AS R9			
R13	RESISTOR, FIXED, COMPOSITION, 3.9K, ±5%, 1/2W	RC20GF392J	81349	2
R14	SAME AS R4			
R15	RESISTOR, FIXED, COMPOSITION, 6.8K, ±5%, 1/2W	RC20GF682J	81349	2
R16	RESISTOR, FIXED, COMPOSITION, 100K, ±5%, 1/2W	RC20GF104J	81349	4
R17	RESISTOR, VARIABLE, 100K, ±10%, 1/4W	U201R104B	11237	1
R18	SAME AS R16			
R19	RESISTOR, FIXED, COMPOSITION, 5.6 MEGO, ±5%, 1/2W	RC20GF565J	81349	1
R20	SAME AS R15			
R21	RESISTOR, VARIABLE, 25K, ±10%, 1/2W	PQ11-120	75042	2
R22	SAME AS R16			
R23	SAME AS R16			
R24	RESISTOR, FIXED, COMPOSITION, 3.3K, ±5%, 1/2W	RC20GF332J	81349	2
R25	RESISTOR, FIXED, COMPOSITION, 39K, ±5%, 1/2W	RC20GF393J	81349	1
R26	RESISTOR, FIXED, COMPOSITION, 2.2K, ±5%, 1/2W	RC20GF222J	81349	2
R27	RESISTOR, FIXED, COMPOSITION, 470 OHMS, ±5%, 1/2W	RC20GF471J	81349	1
R28	SAME AS R4			
R29	RESISTOR, FIXED, COMPOSITION, 1.5K, ±5%, 1/2W	RC20GF152J	81349	9
R30	RESISTOR, FIXED, COMPOSITION, 51K, ±5%, 1/2W	RC20GF513J	81349	1
R31	RESISTOR, FIXED, COMPOSITION, 1.2K, ±5%, 1/2W	RC20GF122J	81349	4
R32	RESISTOR, FIXED, COMPOSITION, 15K, ±5%, 1/2W	RC20GF153J	81349	3
R33	SAME AS R26			

TABLE 6-2. PARTS LIST (Continued)

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	UNITS PER ASSY
R34	SAME AS R8			
R35	SAME AS R29			
R36	RESISTOR, FIXED, COMPOSITION, 390 OHMS, ±5%, 1/2W	RC20GF391J	81349	1
R37	SAME AS R32			
R38	SAME AS R31			
R39	RESISTOR, FIXED, COMPOSITION, 100 OHMS, ±5%, 1/2W	RC20GF101J	81349	8
R40	SAME AS R29			
R41	SAME AS R21			
R42	SAME AS R31			
R43	SAME AS R39			
R44	SAME AS R29			
R45	SAME AS R29			
R46	SAME AS R13			
R47	RESISTOR, FIXED, COMPOSITION, 330 OHMS, ±5%, 1W	RC32GF331J	81349	1
R48	SAME AS R39			
R49	SAME AS R31			
R50	RESISTOR, FIXED, COMPOSITION, 2K, ±5%, 1/2W	RC20GF202J	81349	1
R51	SAME AS R32			
R52	RESISTOR, FIXED, COMPOSITION, 910 OHMS, ±5%, 1/2W	RC20GF911J	81349	1
R53	SAME AS R39			
R54	RESISTOR, FIXED, COMPOSITION, 4.7 OHMS, ±5%, 1/2W	RC20GF4R7J	81349	1
R55	SAME AS R39			
R56	RESISTOR, FIXED, COMPOSITION, 10 OHMS, ±5%, 1/2W	RC20GF100J	81349	1
R57	SAME AS R8			
R58	SAME AS R29			
R59	SAME AS R8			
R60	SAME AS R8			
R61	RESISTOR, FIXED, COMPOSITION, 220 OHMS, ±5%, 1/2W	RC20GF221J	81349	2
R62	RESISTOR, FIXED, COMPOSITION, 51 OHMS, ±5%, 1/2W	RC20GF510J	81349	2
R63	SAME AS R39			
R64	SAME AS R24			
R65	SAME AS R29			
R66	SAME AS R29			
R67	SAME AS R8			

TABLE 6-2. PARTS LIST (Continued)

REF SYMBOL	DESCRIPTION	MANUFACTURER'S PART NUMBER	MFR CODE	UNITS PER ASSY
R68	SAME AS R39			
R69	SAME AS R8			
R70	SAME AS R8			
R71	RESISTOR, FIXED, COMPOSITION, 470K, ±5% 1/2 W	RC20GF474J	81349	1
R72	SAME AS R61			
R73	SAME AS R62			
R74	SAME AS R8			
R75	RESISTOR, FIXED, COMPOSITION, 1.8K, ±5%, 1/2W	RC20GF182J	81349	1
R76	RESISTOR, VARIABLE, 50K, ±10%, 1/2W	PQ11-123	75042	1
R77	RESISTOR, FIXED, COMPOSITION, 200K, ±5% 1/2W	RC20GF204J	81349	1
R78	SAME AS R29			
R79	RESISTOR, FIXED, COMPOSITION, 4.7K, ±5% 1/2W	RC20GF472J	81349	1
R80	SAME AS R39			
R81	SAME AS R6			
R86	SAME AS R9			
S1	SWITCH, ROTARY	MRA-2-5S	95146	3
S2	SWITCH, ROTARY, 6 POLE, 5 POSITIONS	PA1021	71590	1
S3	SWITCH, ROTARY, 2 POLE, 3 POSITIONS	13604-1	11237	1
S4	SAME AS S1			
S5	SWITCH, SLIDE, DPDT	A709936	82199	1
S6	SWITCH, TOGGLE	CK7201	09353	1
S7	SAME AS S1			
T1	TRANSFORMER, POWER	165928	82199	1
U1	INTEGRATED CIRCUIT	SN74121	01295	2
U2	SAME AS U1			
W1	CABLE, POWER	B160833	82199	1
XF1	FUSEHOLDER	005626	82199	1
XQ20	SOCKET, TRANSISTOR	58F328	02929	2
XQ21	SAME AS XQ20			

POLARAD ELECTRONICS,INC.

5 Delaware Drive Lake Success,New York 11042 516-328-1100

REQUEST FOR MAINTENANCE

FROM:

COMPANY NAME _____ DATE: _____

ADDRESS: _____ INDIVIDUAL: _____

_____ POSITION: _____

_____ PHONE NO. _____ EXT. _____

_____

SECTION OR DIVISION: _____

EQUIPMENT: _____ DATE OF PURCHASE: _____

MODEL _____ SERIAL NO. _____ ORDER NO. _____

_____

TROUBLE REPORT:

A. Description of trouble _____

_____

_____

_____

_____

_____

B. Has trouble been localized? _____ If so, how and where: _____

_____

_____

_____

_____

_____

C. Instruments used and measurements taken, if any: _____

_____

_____

_____

_____

D. Is trouble intermittent? _____

E. Hours of operation prior to this trouble _____

F. Date troubled occurred _____

G. Was factory consulted by telephone or letter prior to this request? _____

If so, give date and person to whom directed: _____

_____

H. Additional comments: _____

_____

_____

_____

_____

_____

_____

_____

When trouble develops requiring factory assistance, complete this form and send to:

Polarad Electronics, Inc.
5 Delaware Drive
Lake Success, New York 11042
Attn: Service Department

After this report has been analyzed by the Service Department, you will be notified when a field service engineer will call on you to make the necessary repairs. If your trouble can best be corrected at the factory, we will notify you with instructions and authorization for returning the equipment.

NO EQUIPMENT MAY BE RETURNED TO THE FACTORY WITHOUT WRITTEN AUTHORIZATION

MP MASTER
MA30883